PLAINTIFF'S EXHIBIT

MAC-18

MAGUIRE, VOORHIS & WELLS, P.A.

Attorneys at Law

TWO SOUTH ORANGE PLAZA
2 SOUTH ORANGE AVENUE
ORLANDO, FLORIDA 32801
TELEPHONE (407) 244-1100
FACSIMILE (407) 423-8796

P.O. BOX 633
ORLANDO, FLORIDA 32802

DIRECT DIAL
(407) 244-1165
DIRECT FACSIMILE
(407) 648-4864
INTERNET E-MAIL
CKOLOS@MVW.COM

CHRIS N. KOLOS

July 2, 1997

David M. Lipman, Esq.
599 SW 74th Street
Suite 304
Miami, FL 33143

Re: ***Anne M. Tinker, Executrix of the Estate of Timothy W. Tinker, Deceased vs. A.E. Clevite, et al.*** **Ontario County Index No. 83778.**

Dear Mr. Lipman:

Enclosed please find what I believe will be the final production to be made by Mack Trucks, Inc. in response to paragraphs 7 and 11 of Plaintiff's Request for Production.

If you have any questions regarding the above, please do not hesitate to contact me.

Sincerely,

Chris N. Kolos

CNK:jo
Enclosures

organization changed and as employees changed jobs. Accordingly, Mack Trucks cannot represent that these supplemental responses contained herein provide all information requested; rather, these supplemental responses reflect information obtained before this date by Mack Trucks pursuant to a reasonable and duly diligent search and investigation in those areas where responsive information was expected to be found. To the extent that the request purports to require more, Mack Trucks objects on grounds that include that compliance with the request would impose an undue burden and expense.

These supplemental responses are intended to be accurate to the best of Mack Truck's knowledge and belief as of the time of the service of this supplemental response. To the extent that the supplemental responses are not consistent with any previous responses made in other cases, these supplemental responses are intended to supersede such earlier responses. Mack Trucks reserves the right to supplement these supplemental responses should it discover new information.

Some of the discovery requests ask for "all" documents that may pertain to a subject. Mack Trucks objects to requests for any and all of something on grounds that the requests are overly broad and unduly burdensome.

You have served Mack Trucks with discovery and yet you already may have some pertinent information or documents, perhaps even some information or documents not received from Mack Trucks. Mack Trucks objects on the grounds that it would be less burdensome, more convenient and less expensive for you to identify what documents you already have that fall within the scope of these requests. This would accomplish several purposes: (a) it would obviate Mack Trucks having to search

for and copy documents already in your possession; (b) it would enable Mack Trucks to use the documents provided by you as guides in looking for related material; and (c) it would, if your purposes were to obtain authentication of particular documents, enable Mack Trucks to authenticate the copies provided by you without having to conduct an uninformed search for those documents in Mack Trucks' files.

Mack Trucks further objects to requests where the matter sought is neither relevant to the subject matter involved in the pending action nor reasonably calculated to lead to the discovery of admissible evidence.

Where Mack Trucks personnel have stored responsive documents, whether kept together by folder, clip, staple, or otherwise, only the responsive document will be produced.

Documents offered by Mack Trucks will be made available by providing marked usable copies for review in the office of Mack Trucks' counsel.

The Plaintiff has sued Mack Trucks, Inc. individually as well as successor to Brockway Inc. Mack Trucks is not a successor to Brockway, Inc. Rather, Brockway Motor Trucks, a division of Mack Trucks is a successor to the Brockway Motor Trucks Co. Brockway Motor Trucks, a division of Mack Trucks, Inc. ceased doing business in 1977. Accordingly, the responses herein pertain to Mack Trucks individually only. Since Brockway Motor Trucks, a division of Mack Trucks ceased doing business in 1977, business records of that entity which are still available for inspection are stored in Hagerstown, Maryland. It is unknown whether such records would reveal information responsive to this request to produce. As the burden of deriving or ascertaining the responses to this request to produce from a review of such records

is substantially the same for plaintiff as it is for Mack Trucks, Mack Trucks will make these documents available for review by Plaintiff. In accord with the applicable rules of civil procedure, Mack Trucks will provide assistance to the Plaintiff in locating and identifying the records at the time of inspection.

DEFINITIONS

As used in Mack Trucks' objections to these requests:

(I) "Lack of Relevance" means that a request calls for information which is not relevant to the subject matter of this action and is not reasonably calculated to lead to the discovery of admissible evidence;

(ii) "Unduly Burdensome" means that it would be oppressive, time consuming or expensive to require Mack to compile and furnish the information in light of the degree of its relevance and materiality, if any;

(iii) "Overly broad" means that such request is overly broad as to scope, time or location;

(iv) "Lack of Particularity" means that a request does not state with reasonable particularity the information to be furnished, is vague and ambiguous or incomprehensible;

(v) "Improper Assumption" means that a request assumes facts which are not true or accurate;

(vi) "Improper Opinion" means that a request improperly calls for an opinion, conclusion, contention or inference;

(vii) "Privileged" means a request calls for information protected by the

attorney/client privilege or the work-product doctrine or the rule protecting materials prepared in anticipation of or in connection with litigation; and

(viii) "Premature" means that a request calls for an opinion or contention that relates to fact or the application of law to fact and should not properly be required to be responded to at this time.

These comments and objections are incorporated into each Mack supplemental response set forth below as if they were set forth in their entirety as they apply to each supplemental response. Supplemental responses made after objections are not waivers of objections.

SUPPLEMENTAL RESPONSES

7. All sales brochures; promotional pamphlets; product manuals; specification sheets; instructional materials; safety sheets; assembly maintenance, handling and replacement instructions; circulated or utilized by the Defendant between 1970 through 1980 pertaining to asbestos containing: (1) brake products, including but not limited to brake shoes and brake linings, brake pads, and brake assemblies, (2) clutch products including but not limited to clutch or clutch facings, and (3) gaskets.

RESPONSE: Objections: lack of relevance; burden; overly broad; lack of particularity; premature. Without waiving these objections, documents responsive to this request are attached hereto. Diligent search continues for any additional responsive documents.

11. All sales brochures; promotional pamphlets; product manuals; specification sheets; instructional materials; safety sheets; assembly maintenance, handling, and replacement instructions; circulated or utilized by the Defendant between 1970 through 1980 pertaining to asbestos containing: (1) brake products, brake pads, and brake assemblies, (2) clutch products including but not limited to clutch or clutch facings, and (3) gaskets, utilized in all engines and vehicles other than automobiles.

RESPONSE: Objections: lack of relevance; burden; overly broad; lack of particularity; premature. Without waiving these objections, documents responsive to this request are attached hereto. Diligent search continues for any additional responsive documents.

Dated: 4/22/97
Orlando, Florida

MAGUIRE, VOORHIS & WELLS, P.A.
Two South Orange Plaza
2 South Orange Avenue
Post Office Box 633
Orlando, Florida 32802-0633
Phone: (407) 244-1100
Fax: (407) 423-8796

Attorneys for Defendant, MACK TRUCKS, INC.

TO: Michael A. Ponterio, Esq.
Lipsitz & Ponterio, LLC
135 Delaware Avenue
Suite 506
Buffalo, NY 14202-2410

David M. Lipman, Esq.
5901 S.W. 74 Street
Suite 304
Miami, FL 33143-5186

cc: All Counsel of Record

MACK

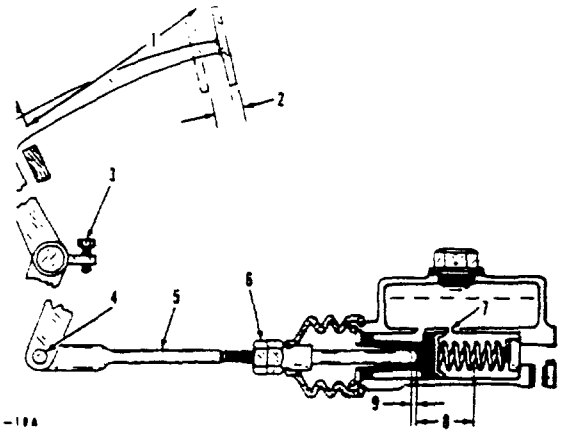
HIGHWAY VEHICLE SERVICE MANUAL

Mack TRUCKS

MACK TRUCKS, INC.
One of The Signal Companies

TS442 10/67 10M
TS442 REV. 8/69 10M
TS442 REV. 5/71 10M
Printed in U.S.A.

TS 442



1. Pedal Height
2. Free Pedal
3. Adjusting Capscrew
4. Clevis Pin
5. Rod
6. Locknut
7. Compensating Port
8. Piston Travel
9. Pushrod-Piston Clearance

Figure 13-28. Pedal Adjustment Conventional Cab

System bleeding is performed in the usual way except that bleeder connection is made at the stop light switch tee, located on the pressure side of master cylinder.

1. Make certain that brake fluid reservoir is filled to proper level. Fill if necessary.

2. Remove stop light switch from the tee on pressure side of master cylinder. The master cylinder is located on the firewall inside vehicle cab. Take necessary precautions to protect cab floor mat from damage by brake fluid.

3. Attach pressure ball line into the 1/8 inch female pipe thread where the stop light switch was removed and open pressure ball valve.

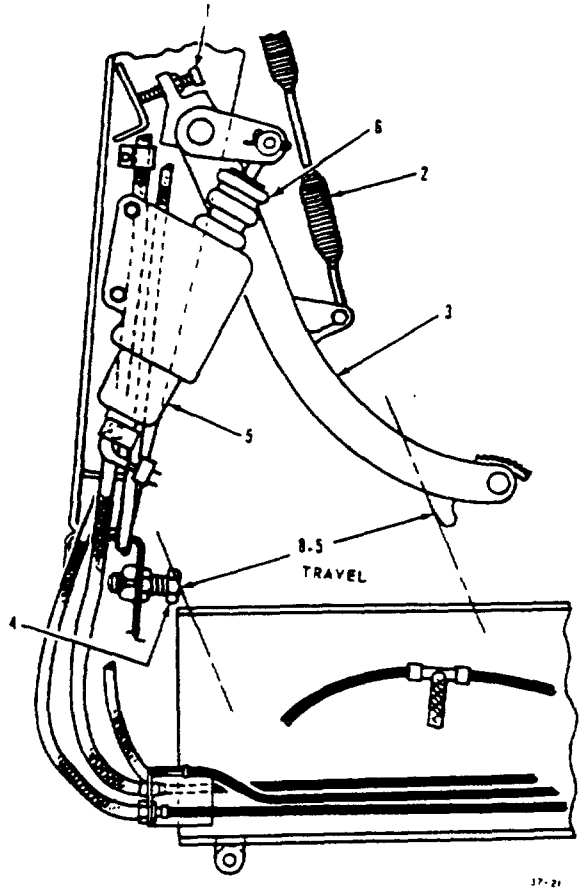
NOTE

To satisfactorily bleed system, the brake pedal must be fully depressed after the pressure ball is attached and valve opened. This closes ports in master cylinder and allows fluid to fill brake lines instead of reservoir only.

4. After bleeding all brake lines, close pressure ball valve and carefully release brake pedal. Remove pressure ball.

5. Reinstall stop light switch.

Pedal adjustment, see Figure 13-29, is controlled by stop bolt (1). Total travel of



1. Stop Bolt
2. Return Spring
3. Pedal
4. Pedal Stop Bolt
5. Master Cylinder
6. Boot

Figure 13-29. Pedal Adjustment Tilt Cab

pedal (3) is nominally 8.5 inches, with stroke limited by pedal stop bolt (4). Adjust stop bolt (1) to provide 0.12 free pedal. At all times ascertain that master cylinder (5) has correct fluid level. Boot (6) is moved upward for this inspection and add, or reservoir fill, is at the piston push rod opening. Spring (2) returns pedal to unapplied position.

Type F Brake

Disassembly and Assembly

1. Remove front wheels and drums.

2. Remove retraction springs and hold-down "C" washers and lift shoes off the backing plate. Do not lose the spring anti-rattle washers, located under each shoe web on the cam stud.

3. To remove wheel cylinders, remove connector tube nuts, anchor bolts and mounting screws. Mark connector tube ports on

each wheel cylinder to avoid errors at assembly. If manifold tubing is installed incorrectly, difficult bleeding may be experienced.

4. Check fit of concentric-ground linings against the fresh drum surface.

NOTE

Every reline should have a fresh drum surface. If drums do not require turning, the preferred method is to take a very light grind on a lathe to remove old lining residue and freshen the surface. The surface can also be renewed by dressing it with fine emery cloth or steel wool.

5. Make sure backing plate and wheel cylinder bolts are tight. Remember that, while upper and lower wheel cylinders are the same, those for right-hand and left-hand brakes have opposite castings and must not be interchanged. The cylinder bore must face in the direction of forward rotation.

6. Install shoes, locating each retraction spring so that its long shank is connected into the heel of the shoe.

7. Install drums and wheels.

8. Check master cylinder for correct fluid level. Add fluid if required.

Adjustment

1. Depress brake pedal several times to center the shoes in drums. See Figure 13-30.

2. As shown in Figure 13-30, place a wrench on cam and shoe guide stud (1) or (2) to adjust one shoe. Rotate wrench in direction of FORWARD wheel rotation to decrease lining-to-drum clearance. Reduce clearance until lining drags on drum.

3. Rotate wrench in opposite direction, to increase clearance, until drag is relieved. Then continue to back off approximately 1/8 turn for running clearance.

4. Place wrench on opposite cam and shoe guide stud (1) or (2) to adjust second shoe. Repeat steps 2 and 3.

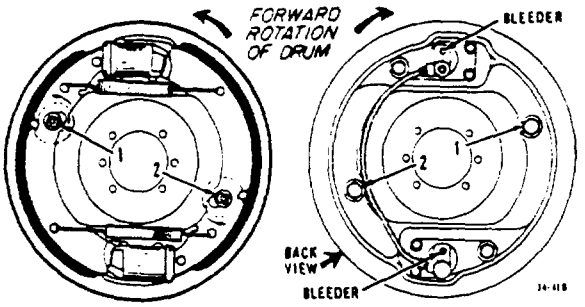


Figure 13-30. Outboard and Inboard Views of Left Front "F" Brake

Type FR-2 Brake

Disassembly and Assembly

1. Remove rear wheels and drums. It may be necessary to back off the adjustment star wheels.

2. Remove retraction springs by sliding looped ends off pins.

3. Remove hold-down lockwires, castellated nuts and plain washers, then lift off shoes.

4. Remove shoe-heel anchor pins; they should pull out of supports easily.

5. Remove star wheel lock springs by removing the attaching screw from each spring.

6. Thread each adjusting screw out from the shoe side of its support. Lift star wheels out of slots.

7. When removing wheel cylinders, mark tube ports on wheel cylinders to avoid an assembly error which might result in difficult bleeding operations.

8. Check fit of the newly lined concentric-ground shoes against the fresh drum surface.

NOTE

Every reline should have a fresh drum surface. If drums did not require turning, the preferred method is to take a very light grind on a lathe to remove old lining residue and freshen the surface. The surface can also be renewed by dressing it with fine emery cloth or steel wool.

9. Make sure backing plate is tight on the axle flange.

10. Insert star wheel in anchor support, thread in adjusting screw and install star wheel lock spring (each anchor support).

11. Install each wheel cylinder so that the longer end, measured from hydraulic port to end of cylinder, faces the shoe toe and adjustment slot.

12. Install each shoe with its toe (identified by cut-away portion of web) positioned next to adjusting screw and star wheel.

13. Install hold-down plain washer and castellated nut at each shoe. Tighten each nut fingertight, then back off 1/4 to 1/3 turn.

14. Install retractor springs.

15. Install drums and wheels.

16. Check master cylinder for correct fluid level. Add fluid if required.

Adjustment. See Figure 13-31

1. Remove adjustment slot covers.

2. Insert clicker wrench or screwdriver into slot (1) or (2), see Figure 13-31, to contact star wheel. Rotate wheel toward axle to decrease clearance until lining drags on drum.

3. Rotate star wheel in the opposite direction until drag is relieved. Operate the brake pedal several times to center the shoes; then check adjustments. Provide running clearance after drag is relieved, by additionally backing off the adjustments five notches for new lining or three notches for worn lining.

4. Repeat steps 2 and 3 on second shoe.

5. Replace adjustment slot covers.

Type FR Brake

Disassembly and Assembly

1. Remove rear wheels and drums. It may be necessary to back off the brake adjustment.

2. Remove retraction springs.

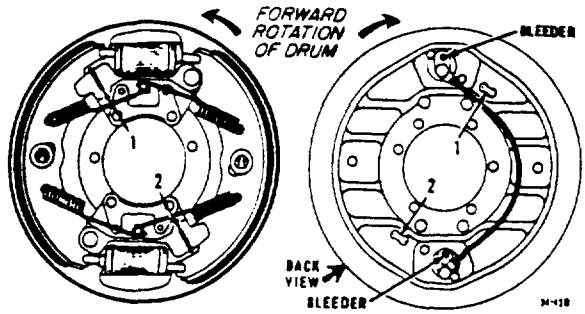


Figure 13-31. Outboard and Inboard Views of Left Rear "FR2" Brake

3. Remove hold-down nut, lockwasher and plain washer at each shoe and remove the shoes.

4. On each shoe, rotate the adjusting worm (forward rotation) until the adjusting screw is threaded free of the worm wheel and shoe. Pry out the worm retainer snap ring to free the remaining parts; that is, the thrust washers, sleeve, worm and worm wheel.

5. To remove a wheel cylinder, disconnect hydraulic tube nut and loosen anchor block nuts. Mark tubing ports on wheel cylinders to avoid an assembly error which might cause difficult bleeding should the manifold tubing be installed in the wrong ports. Take care not to lose spring washers installed on the two locating lugs on each cylinder.

6. Check fit of the new concentric ground lined shoes against the fresh drum surface.

NOTE

Every reline should have a fresh drum surface. If drums did not require turning, the preferred method is to take a very light grind on a lathe to remove old lining residue and freshen the surface. The surface can also be renewed by dressing it with fine emery cloth or steel wool.

7. Make sure each backing plate is tight on the axle flange.

8. If wheel cylinders were removed, make sure that all parts are replaced in correct locations. A spring washer should be installed on each cylinder locating lug, against the cylinder and between it and the cylinder cover straps and anchor block. Each cyl-

inder should be oriented so that the long stroke side (greater length from inlet port to end of casting) faces the adjustment slot in the backing plate and the shoe toe. Assemble the cylinder, cover, and anchor block and mount these parts as a unit.

Torque anchor-block locknuts, as follows:

5/8 x 18 . . . . .105 to 130 lb. ft.
3/4 x 16 . . . . .175 to 220 lb. ft.

9. On each shoe, place adjuster worm in its sleeve and install adjuster parts in the shoe web, one thrust washer at each end of the worm, retainer snap ring on the opposite side of the web from the backing plate. Start the adjuster screw into the worm wheel and rotate the worm wheel (reverse direction) to thread the screw into the shoe web.

10. Install shoes so that adjusting worm in shoe toe is accessible through adjustment slot in backing plate. Install and tighten hold-down bolts, washers, and nuts and connect retraction springs.

11. Install drums and wheels. Lubricate and adjust wheel bearings.

12. Check master cylinder for correct fluid level. Add fluid if required.

Adjustment. See Figure 13-32

1. Remove adjustment slot covers.

2. Insert Allen wrench in adjustment slot (1) or (2), see Figure 13-32, to contact shoe adjusting worm. Rotate wrench in the direction of forward wheel rotation until lining drags on drum.

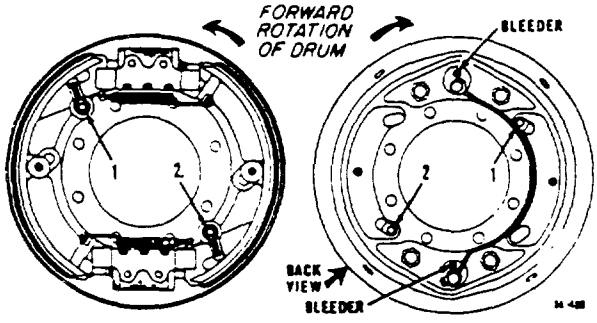


Figure 13-32. Outboard and Inboard Views of Left Rear "FR" Brake

3. Rotate wrench in opposite direction, to increase clearance, until drag is relieved. Then rotate adjustment one additional turn (two turns for new linings) to provide working clearance.

4. Repeat steps 2 and 3 on the second shoe.

5. Replace adjustment slot covers.

WHEEL CYLINDERS

CAUTION

To insure cleanliness, never service wheel cylinders without removing them from the vehicle.

Removal and Installation

1. Clean brake line connection thoroughly.

2. Disconnect brake line and install a clean rubber or wooden plug in end of tubing.

3. Protect brake linings from brake fluid and remove cylinder. If cylinder is scored, replacement by a new cylinder is preferable to honing the old one.

4. Reverse removal procedure to install cylinder.

NOTE

Do not assemble cylinder parts dry. Coat parts and inside of cylinder bore with clean brake fluid before assembly.

5. Bleed cylinder until a solid stream of fluid, free of air bubbles, is obtained.

WEDGE ACTUATED BRAKES

As currently employed, these double-actuated brakes are used in straight air or air over hydraulic systems. Mountings are either spider or backing plate, with air chambers or hydraulic cylinders serving as power units. Auxiliary spring brakes may also be used in conjunction with these assemblies. The assembly shown in Figure 13-33 is a straight air, spider mounted unit, with the auxiliary spring brake sectioned.

Wedge actuated brakes differ from the conventional type in that they do not utilize slack adjusters and brake camshafts for application of linings to brake drums. Air, or hydraulic pressure, forces a wedge between plungers, causing the plungers to spread

2. Replace springs if cracked or defective. Check all springs on a spring tester. Replace all that do not meet specifications.

3. Replace thrust washer if worn, bent or defective.

4. Replace worn release levers, springs and ball seats. Check levers with a straightedge and 11/16 inch ball (17-T-1126), see Figure 5-3, and if bent so that dimension (1) is more than 11/32 inch when measured at a point where distance (2) is 2-1/2 inch, replace the lever.

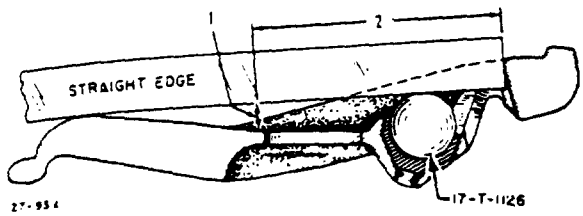


Figure 5-3. Checking Release Lever for Bend

5. If pressure plate is scored, heat checked, or warped more than 0.020 inch, it must be replaced or refaced. Remove only enough metal to obtain a smooth flat surface. Finish with a light cut and polish with emery cloth. When thickness (1) becomes less than the worn limit given in specifications, the plate must be replaced. Measure at outer spring pocket, see Figure 5-4. Measuring at inner pocket is not accurate, if pressure plate is dished. If cleft lugs are worn, cracked or distorted, replace the plate. Replace eyebolts if they are distorted, have worn threads or keyways.

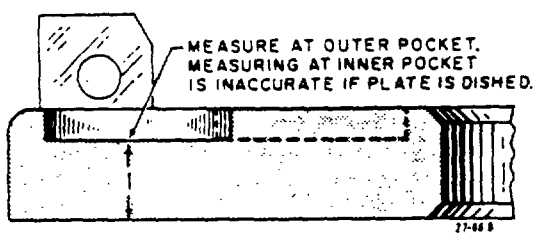


Figure 5-4. Pressure Plate Thickness Dimension

6. If flywheel is warped or heat checked and surface is refinished, maintain the 1.594 inch dimension between disc surface and bolting face for proper release lever adjustment. See Figure 5-5. No more than .070 inch maximum may be removed by grinding.

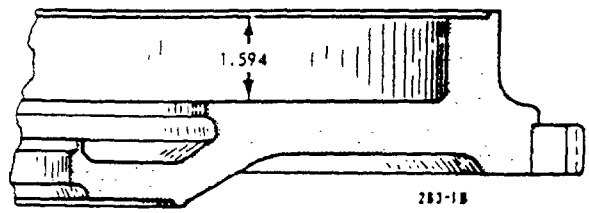


Figure 5-5. Flywheel Rubbing Surface-to-Clutch Cover Bolting Surface Dimension

7. Inspect driven disc assembly for cracks, loose rivets, worn splines, warped or dished condition. If cracked, or hub splines are worn excessively, replace disc assembly. If facings are worn down nearly even with countersunk facing-retaining rivet heads and provided assembly is in otherwise good condition, it may be rebuilt.

8. Pilot bearing should be removed, cleaned and checked each time clutch or engine is removed. Discard bearing if balls or races are chipped or scored. After inspection, hand-pack bearing with recommended clutch pilot bearing grease and install bearing in flywheel. Tap into place with shielded side toward clutch and snap ring seated in counterbore.

NOTE

Old bearings without a snap ring cannot be used in new through-bored flywheels.

After bearing is properly installed, pack the cavity in back of the bearing with recommended clutch pilot grease.

NOTE

To prevent damage to the bearing seal when the transmission is assembled to the engine, the space occupied by the main driving pinion pilot must not be filled with grease. See Figure 5-6.

All current Mack-made engine flywheels have been manufactured by boring the clutch pilot bearing hole straight-through and counterboring a recess to provide proper positioning for the snap ring type pilot bearings now in use.

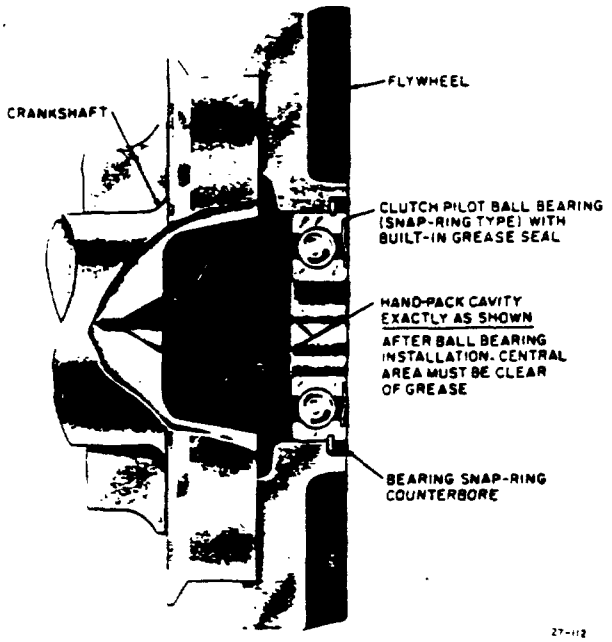


Figure 5-6. Cut-away View of Clutch Pilot Bearing Grease Reservoir Correctly Packed

CAUTION

Do not install a new snap ring bearing in an old flywheel without removing the snap ring and discarding. In old flywheels without the counterbore, the snap ring would position the bearing too far rearward, which would result in early bearing failure and considerable damage to costly components. Use only the recommended snap ring type bearings specified. These bearings will function without premature failure where slight misalignment exists between engine and transmission.

Before assembling the clutch, a positive wear check should be made to insure that it will provide maximum disc wear. This check will uncover any wear conditions that might prevent full release lever travel and allow corrections to be made before the clutch is assembled.

Place the pressure plate assembly and cover (without springs) into position as shown in Figure 5-7, making sure that shims of the correct thickness (.200) are inserted between cover and spacer (17-T-1763). Install each release lever and while pressing firmly on the fulcrum, measure distance (1) inboard end of lever is above cover.

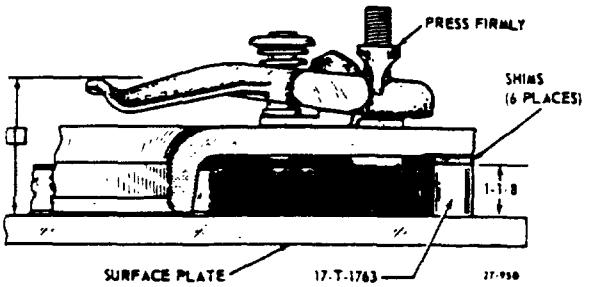


Figure 5-7. Wear Check

Correct height for the CL-28 Series, 3-9/32 inches, for the CL-40 Series, 3 inches.

Reassembly

1. Remove the shims used for the wear check. Lightly lubricate pivot ball bushing, fulcrum groove, eyebolt pin and inboard end of release lever with clutch lever grease.

2. Place the pressure plate on a face plate with the spring pockets of the pressure plate up. Place heat-insulating washers and the springs in the pressure plate spring pockets.

NOTE

If pressure plate was refaced, insert washers into the spring cups of a thickness equal to the metal removed from the pressure plate. Shellac the washers in place to facilitate retention.

3. Place the cover in position, align the springs in the pockets. Bottom the screws of the three spring retention tools into the threaded holes of the pressure plate and bring the tool nuts down snugly against the tool bracket. Tighten the tool nuts alternately, one turn at a time, guiding the pressure plate lugs into the clutch cover holes until the inside face of the cover is 1.125 inch from the face of the pressure plate. Special tool (17-T-1763), is used to facilitate obtaining this dimensions, see Figure 5-8.

4. Place the clutch release levers on the ball fulcrums and eyebolt shanks. Place the lever springs on the spring pins with the small diameter against the release levers.

assembled in their original positions. This is necessary in order not to disturb the dynamic balance of the clutch.

1. Equally space three steel blocks 3/8 inch thick, on bed of arbor or drill press.

2. Place clutch with pressure plate side down, on blocks. (This is done in order to raise clutch to permit disassembly).

3. Place a block of wood, such as a two by four, across cover plate in a position that does not interfere with tips of release levers, as shown in Figure 5-10. Compress clutch assembly slightly, removing lever adjusting screw locknuts.

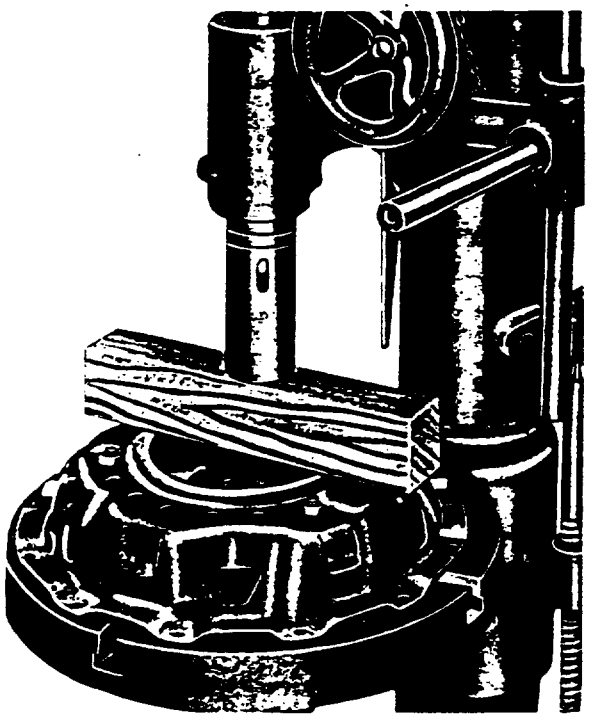


Figure 5-10. Compressing Clutch

4. Turn each lever adjusting screw down (clockwise), a few turns with a screwdriver, releasing spring tension a small amount. Repeat operation until all lever adjusting screws are entirely free of cover plate. Release remaining spring tension, and lift cover plate off pressure springs.

5. Pressure springs may now be removed. After extracting cotter pins and lever pins, remove release levers.

Inspection and Repair

Clean all parts thoroughly with a suitable safe solvent, then inspect carefully for excessive wear, distortion, or cracks as outlined below:

1. Check cover plate for distortion, excessive wear at indentations which register between drive bosses on pressure plate, and for stripped threads in holes accommodating release lever adjusting screws. If the above mentioned conditions are apparent, replacement of cover plate is required.

2. Replace springs if cracked or defective. Check all springs on a spring tester. Replace all that do not meet specifications.

3. Replace release levers that are badly worn on tips (this is an indication of a sticking release bearing), worn threads on lever adjusting screws and nuts, or where binding appears to be present, which retards free back and forth movement.

NOTE

Release levers are serviced as a subassembly only, and consist of lever, adjusting screw, roller, roller block, lever spring and spring retaining pin.

4. If pressure plate shows signs of scoring, excessive wear at lever pin holes, inside of drive bosses, heat checking, or if warped more than .020 inch, plate must be refaced or replaced. (When refacing pressure plate, remove only sufficient metal to obtain a smooth flat surface.)

NOTE

When pressure plate thickness becomes less than 1.141 inch, replacement is necessary.

5. If flywheel is warped or heat checked and surface is refinished, maintain the 1.188 inch dimension between disc surface and bolting face for proper release lever adjustment. No more than .070 inch maximum may be removed by grinding.

6. Inspect driven disc assembly for cracks, loose rivets, worn splines, warped or dished condition. If cracked, or hub splines are worn excessively, replace disc assembly.

If facings are worn down nearly even with countersunk, facing-retaining rivet heads and provided assembly is in otherwise good condition, it may be rebuilt.

7. Pilot bearing should be removed, cleaned and checked each time clutch or engine is removed. Discard bearing if balls or races are chipped or scored. After inspection, hand-pack bearing with clutch pilot bearing grease and install bearing in flywheel. Tap into place with shielded side toward clutch.

After bearing is properly installed, pack the entire cavity in back of the bearing with the same specified clutch pilot grease.

NOTE

To prevent damage to the bearing seal when the transmission is assembled to the engine, the space occupied by the main driving pinion pilot must not be filled with grease. See Figure 5-11.

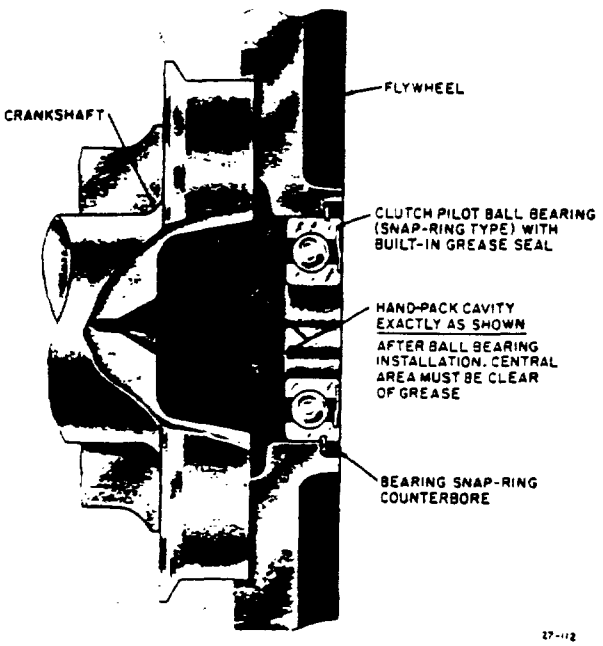


Figure 5-11. Cut-away View of Clutch Pilot Bearing Grease Reservoir Correctly Packed

Use only the recommended pilot bearings specified. These bearings will function without premature failure where slight misalignment exists between engine and transmission.

Reassembly

1. Mount release lever assemblies on pressure plate. Set pressure plate assembly on three equally spaced steel blocks 3/8 inch thick, on bed of arbor or drill press, plate side down.

2. Place pressure springs in position on pressure plate, as shown in Figure 5-12.

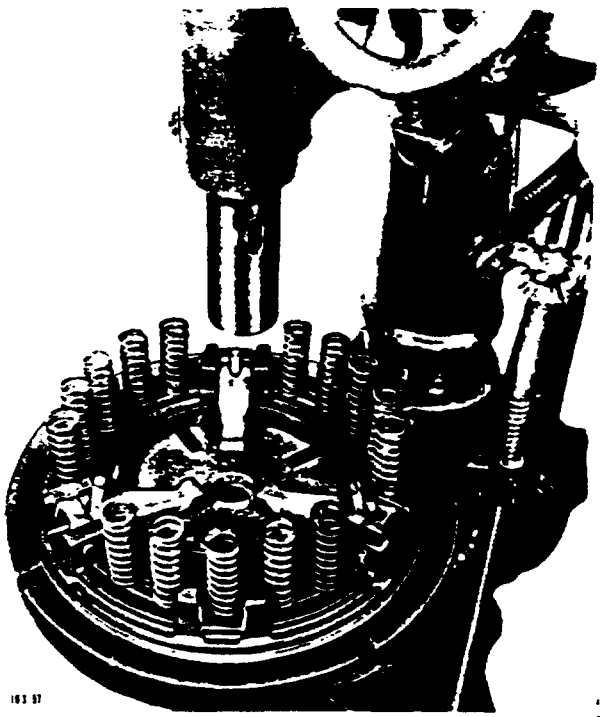


Figure 5-12. Assembling Clutch

3. Lay cover plate over springs, being sure that all springs are seated on bosses of pressure plate, and around indentations on inside of cover.

4. If pressure plate was refaced, it will be necessary at assembly, to add shims under each pressure spring equal to total metal removed.

5. Compress assembly slowly, aligning lever adjusting screws with threaded holes in cover plate. (The indentations inside cover, should enter the spaces between drive bosses on pressure plate freely.) With screwdriver, thread ends of adjusting screws into cover evenly, until screws protrude about 1/2 inch. Hold assembly compressed, while placing locknuts in position, but do not tighten.

6. To facilitate installation on flywheel, place wood blocks approximately 3/8 inch thick, between the tops of release levers and inner rim of cover plate. (Be sure these stay in position as all tension is released).

7. Insert the three spring retention tools (17-T-1766), through cover and bottom in tapped holes in pressure plate (center hole of each five series in cover). With pres-

2. While holding spring retention tool screws, back off tool nuts alternately, making one turn at a time. When spring is entirely relieved, back out the three tool screws.

3. Remove clutch cover and springs. If heat-insulating washers are removed from pressure plate spring pockets, retain them for reassembly. The eyebolts need not be removed, unless inspection reveals distortion or loose fit on pins.

Inspection and Repair

Remove all traces of dirt and oil with a suitable safe solvent. Inspect parts carefully for cracks, distortion or excessive wear as follows:

1. If cover is cracked or distorted, replace. Tack-weld loose spring cups (on covers having this construction) replace worn or loose ball-fulcrums. Replace loose or bent release lever spring pins.

2. Replace springs if cracked or defective. Check all springs on a spring tester. Replace all that do not meet specifications.

3. Replace thrust washer if worn, bent or defective.

4. Replace worn release levers, springs and ball seats. Check levers with a straightedge and 11/16 inch ball (17-T-1126) as illustrated, in Figure 5-14 and if bent so that dimension (1) is more 11/32 inch when measured at a point where distance (2) is 2-1/2 inch, replace the lever.

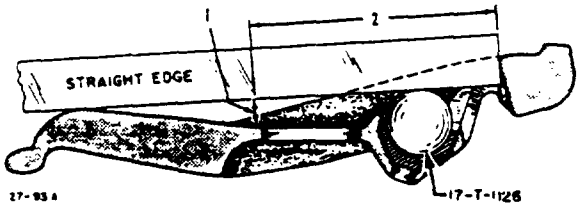


Figure 5-14. Checking Release Lever for Bend

5. If pressure and intermediate plates are scored, heat checked, or warped more than 0.020 inch, they must be replaced or refaced. Remove only enough metal to obtain a smooth flat surface. Finish with a light cut and polish with emery cloth. When thickness (1) becomes less than the worn limit given in specifications, the plate must be replaced. Measure at outer spring pocket as shown in Figure 5-15. Measuring at inner pocket is not accurate if pressure plate is dished. If cleft lugs are worn, cracked or distorted, replace the plate. The intermediate plate features a double set of drive slots for increased service life. At clutch installations after rebuild, it is recommended that the set with less wear be used. Replace eyebolts if they are distorted, have worn threads or keyways.

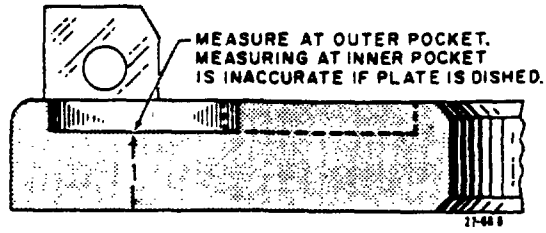


Figure 5-15. Pressure Plate Thickness Dimension

6. If flywheel is warped or heat checked and surface is refinished, maintain the 2.797 inch dimension between disc surface and bolting face for proper release lever adjustment. See Figure 5-16. No more than .070 inch maximum may be removed by grinding.

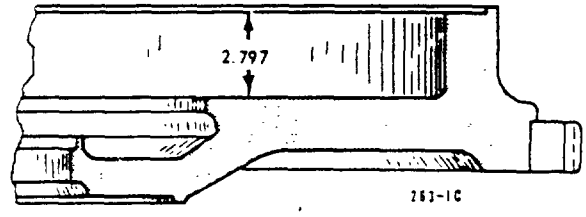


Figure 5-16. Flywheel Rubbing Surface-to-Clutch Cover Bolting Surface Dimension

Intermediate plate drive pins should be inspected for abnormal wear.

When pins have been removed to permit flywheel machining, or require replacement, squareness between flywheel friction and pin drive faces must be maintained at installation. A positioning tool will assist in establishing necessary alignment.

Suitable for this purpose, will be a slotted steel block 4 inches long, 2-1/2 inches wide and 1-1/2 inches thick. One 2-1/2 inches x 4 inches face should be ground for maximum flatness, as it will constitute the major working surface. A 3/16 inch x 45° chamfer along all edges of this face will tend to prevent burrs that would affect accuracy. See Figure 5-17.

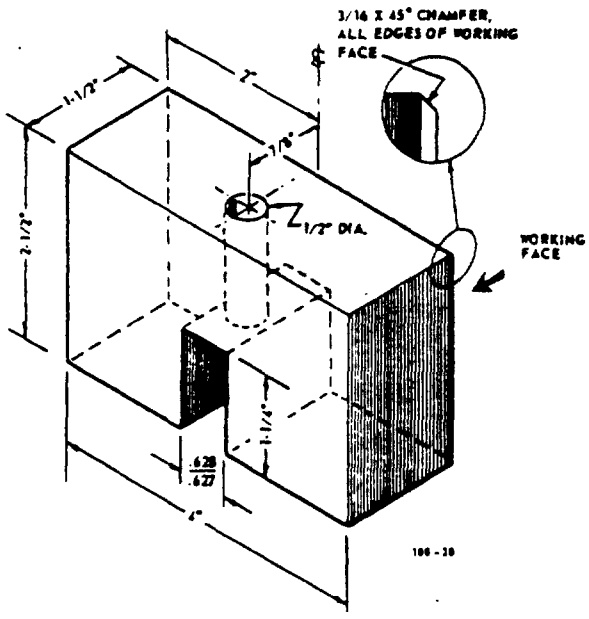


Figure 5-17. Drive Pin Positioning Tool

Midway between ends of the 4 inch length, a .628/.627 inch wide slot 1-1/4 inch deep should be machined through the 1-1/2 inch thickness. The slot must be exactly square with the ground face for it will determine flywheel to drive pin head alignment. A half -inch drift pin clearance hole, drilled from the side opposite, and intersecting with, the slot will complete the tool. Hole centerline should be 7/8 inch from the ground face, so that driving force will be centered over the head. Magnetizing the block will minimize movement during driving and lessen possibility of marring flywheel face.

In use, the threaded portion of the pin is inserted in the flywheel hole. The positioning tool slot is placed over the drive head, with the ground surface held flat against the flywheel friction face. The pin is then driven until fully seated.

7. Inspect driven disc assembly for cracks, loose rivets, worn splines, warped or dished condition. If cracked, or hub splines are worn excessively, replace disc assembly. If facings are worn down nearly even with countersunk facing-retaining rivet heads and assembly is in otherwise good condition, it may be rebuilt.

8. Pilot bearing should be removed, cleaned and checked each time clutch or engine is removed. Discard bearing if balls or races are chipped or scored. After inspection, hand-pack bearing with clutch pilot bearing grease and install bearing in flywheel. Tap into place with shielded side toward clutch and snap ring seated in counterbore. Old bearings without a snap ring cannot be used in new through-bored flywheels.

After bearing is properly installed, pack the entire cavity in back of the bearing with the same specified clutch pilot grease.

NOTE

To prevent damage to the bearing seal when the transmission is assembled to the engine, the space occupied by the main driving pinion pilot must not be filled with grease. See Figure 5-18.

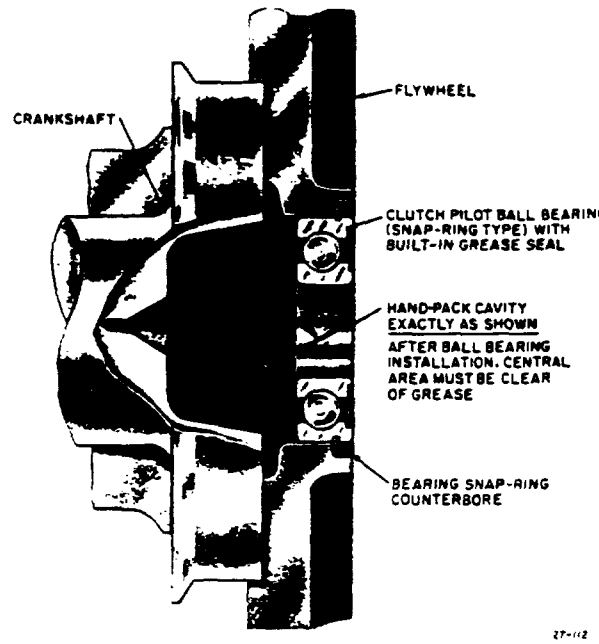


Figure 5-18. Cut-away View of Clutch Pilot Bearing Grease Reservoir Correctly Packed

All current Mack-made engine flywheels have been manufactured by boring the clutch pilot bearing hole straight-through and counterboring a recess to provide proper positioning for the snap ring type pilot bearings now in use.

CAUTION

Do not install a new snap ring bearing in an old flywheel without removing the snap ring and discarding. In old flywheels without the counterbore, the snap ring would position the bearing too far rearward, which would result in

early bearing failure and considerable damage to costly components. Use only the recommended snap ring type bearings specified. These bearings will function without premature failure where slight misalignment exists between engine and transmission.

Before assembling the clutch, a positive wear check should be made to insure that it will provide maximum disc wear. This check will uncover any interference that might prevent full release lever travel and allow corrections to be made before the clutch is assembled.

Place the pressure plate assembly and cover (without springs) into position as shown in Figure 5-19, making sure that shims of the correct thickness (.250) are inserted between cover and spacer (17-T-1763). Install each release lever and while pressing firmly on the fulcrum, measure distance (1) inboard end of lever is raised above cover. Correct height is 3-11/32 inches. Remove any interference that prevents obtaining this dimension.

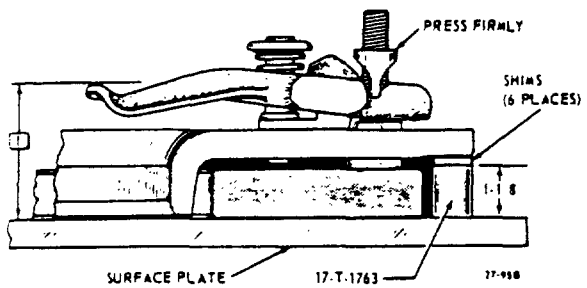


Figure 5-19. Wear Check

Reassembly

1. Remove the shims used for the wear check. Lightly lubricate pivot ball bushing, fulcrum groove, eyebolt pin and inboard end of release lever with clutch lever grease.

2. Place the pressure plate on a surface plate with the spring pockets of the pressure plate up. Place heat-insulating washers and the springs in the pressure plate spring pockets.

NOTE

If pressure plate and intermediate plate were refaced, insert washers into the spring cups of a thickness equal to the metal removed from the pressure plate and intermediate plate. Shellac the washers in place to facilitate retention.

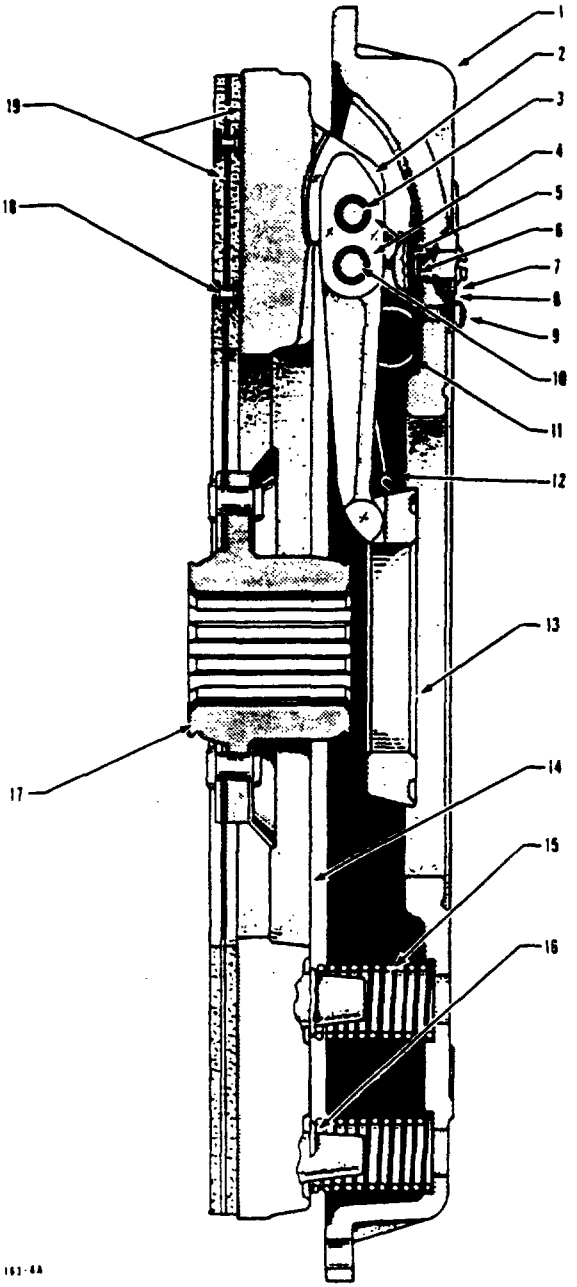
3. Place the cover in position, align the springs in the pockets. Bottom the screws of the three spring retention tools into the threaded holes of the pressure plate and bring the tool nuts down snugly against the tool bracket. Tighten the tool nuts alternately, one turn at a time, guiding the pressure plate lugs into the clutch cover holes until the inside face of the cover is 1.1875 inch from the face of the pressure plate. Special tool (17-T-1763) and a 1/16 inch spacer (17-T-11337), is used to facilitate obtaining this dimension. See Figure 5-20.

NOTE

If the intermediate driving plate is worn or has been machined, the consequent reduction in thickness will produce the same effect as worn clutch discs when the clutch assembly is installed in a vehicle. In an extreme case, one-half the available release collar wear travel may be used up before the vehicle is put back into service.

To compensate for this condition, shims of appropriate thickness must be inserted between cover and spacers (17-T-1763) while the clutch is adjusted. Measure thickness of the intermediate driving plate which will be used with clutch being adjusted and compare with new thickness as shown in specifications. If plate is .010 inch or more below new thickness, secure shims equal in thickness to amount of metal removed and insert them between clutch cover and spacers (17-T-1763) at equally spaced intervals. See Figure 5-20.

4. Place the clutch release levers on the ball fulcrums and eyebolt shanks. Place the lever springs on the spring pins with the small diameter against the release levers. Place the spring washers in position, com-



1. Clutch Cover
2. Release Cover
3. Release Lever Pin
4. Needle Bearings
5. Release Lever Yoke
6. Yoke Leaf Spring
7. Lever Adjusting Nut
8. Adjusting Nut Lock Plate
9. Lock Plate Lock Screw
10. Yoke Clevis Pin
11. Double Torsion Anti-Rattle Spring
12. Thrust Washer Clamp
13. Lever Thrust Washer Ring
14. Pressure Plate
15. Helical, Main Spring
16. Heat Insulator Ring
17. Driven Disc Assembly
18. Facing Rivet
19. Driven Disc Facings

Figure 5-21. Sectional View of CL-58 Series Clutch

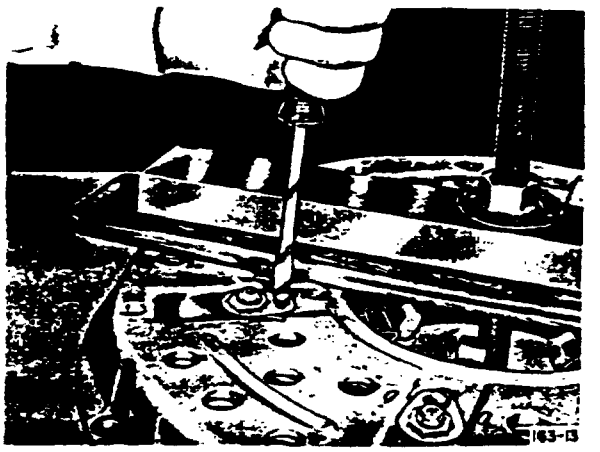


Figure 5-22. Removing Lever Adjusting Nut Lock Plates

main spring insulator washers from pressure plate bosses.

NOTE

Do not remove the six lever anti-rattle springs from the cover unless replacement is necessary.

4. Lay pressure plate on bench and with a soft metal drift, drive hardened lever pins out of pressure plate drive lugs to free release levers. With a pair of pliers, remove cotter pin from each lever yoke clevis pin and then press out each yoke clevis pin by hand.

NOTE

When removing levers from pressure plate drive lugs and lever yoke, be very careful not to lose any of the small uncaged needle rollers.

Inspection and Repair

Remove all traces of dirt and oil with a suitable safe solvent. Inspect parts carefully for cracks, distortion or excessive wear as follows:

1. Replace springs if cracked or defective. Check all springs on a spring tester. Replace all that do not meet specifications.

2. If pressure plate is scored, heat checked, or warped more than .025 inch, it must be replaced or refaced. Remove only enough metal to obtain a smooth flat surface. No more than .070 inch maximum may be removed by grinding.

3. Inspect clutch release lever tips and clevis pin holes for excessive wear. Make sure levers are not bent. Replace where necessary.

4. Inspect release lever yokes for condition of threads. Slight thread damage may be cleaned up with a three-cornered Swiss file. Replace lever yokes if clevis pin holes are elongated.

5. Check clevis pins and lever pins for wear. Replace if wear is excessive. Check lever slotted thrust washer ring for excessive wear. Replace if slots are excessively worn.

6. Check lever needle roller bearings for wear. If flats are such that rollers slide rather than roll, replace rollers.

7. Inspect driven disc assembly for cracks, loose rivets, worn splines, warped or dished condition. If cracked, or hub splines are worn excessively, replace disc assembly.

If facings are worn down nearly even with countersunk facing-retaining rivet heads and provided assembly is in otherwise good condition, it may be rebuilt.

8. If flywheel is warped or heat checked and surface is refinished, maintain dimensions shown in Figure 5-23 between disc surface and bolting face for proper release lever adjustment. No more than .070 inch maximum may be removed by grinding.

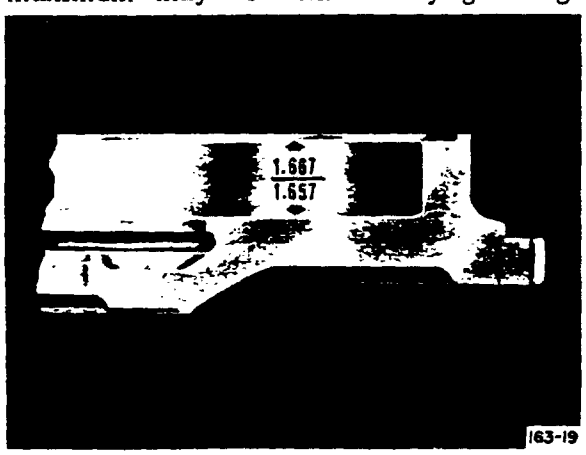


Figure 5-23. Flywheel Rubbing Surface-to-Clutch Cover Bolting Surface Dimension

9. Pilot bearing should be removed, cleaned and checked each time clutch or engine is removed. Discard bearing if balls or races are chipped or scored. After inspection, hand-pack bearing with clutch pilot bearing grease specified and install bearing in flywheel. Tap into place with shielded side toward clutch and snap ring seated in counterbore.

After bearing is properly installed, pack the entire cavity in back of the bearing with the same specified clutch pilot grease.

NOTE

To prevent damage to the bearing seal when the transmission is assembled to the engine, the space occupied by the main driving pinion pilot must not be filled with grease. See Figure 5-24.

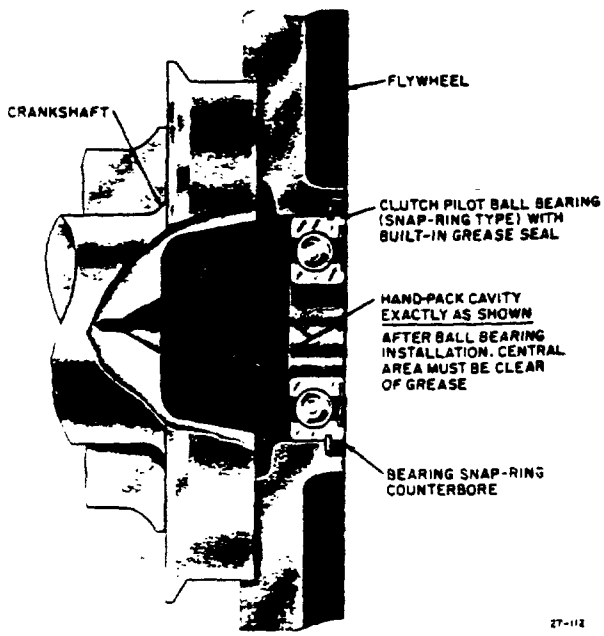


Figure 5-24. Cut-away View of Clutch Pilot Bearing Grease Reservoir Correctly Packed

Use only the recommended snap ring type bearings. These bearings will function without premature failure where slight misalignment exists between engine and transmission.

Reassembly

1. Apply a light coat of clutch lever grease on the loose needle bearings and install rollers in each pin hole of levers. When bearings are installed, apply additional grease to each assembled bearing group.

2. Spread a thin coat of lever grease on the two rubbing flats of each lever and on all yoke rubbing surfaces. Center lever

yoke clevis pin holes over lever inner bearing-lined pin holes and carefully insert clevis pin through the aligned holes. Lock pin in position with cotter pin.

3. Apply a thin even coat of lever grease on all pressure plate drive lug rubbing surfaces. Carefully position lever assembly between drive lugs. Align pin holes in drive lugs with assembled needle rollers and push pin through lugs and bearing opening.

NOTE

Remove all excess grease.

4. Position clutch pressure plate and lever assembly in clutch overhaul machine, arbor press, drill press or whatever clamping arrangement being used. After centering thereon, install heat insulator washers on the spring heat grids, then main springs in their correct specified positions.

NOTE

Except as specified below, install BLACK or COLORLESS main springs on all locating bosses remaining without springs.

CL-58, install an all RED spring on each No. 1 and No. 3 spring boss. CL-581, install an all WHITE spring on each No. 4 and 5 spring boss.

CL-582, install an all WHITE spring on each No. 6 spring locating boss. See Figure 5-25. Install inverted yoke springs on yoke stems.

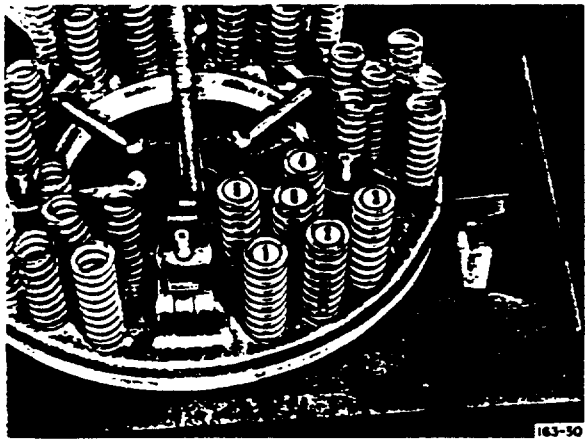


Figure 5-25. Main Spring Arrangement In One of the Six Identical Pressure Plate Segments

NOTE

Make sure leaf springs are inverted on yoke stems and parallel to levers so that their upturned ends will bear against under side of cover when assembled, thus spring-loading each yoke.

5. Position yokes vertically. Position clutch cover over assembly. After centering all main springs in their counterbored seats in cover, set up clamping arrangement and compress springs slowly. Make sure ALL yoke stems are in alignment, then continue to compress springs until all six stems are sticking out of their cover holes.

6. Apply a very thin coat of clutch lever grease to adjusting nut spherical seats in cover. Then install adjusting nuts. Clamping pressure on clutch cover may now be relieved.

7. Lay engine flywheel on bench. Make up four spacers exactly .402 inch thick each and arrange them on flywheel rubbing surface. The spacer thickness of .402 inch corresponds to the mean driven disc assembly thickness under load. See Figure 5-26. Then without disturbing the .402 inch spacer arrangement, position clutch in flywheel counterbore. Install clutch in flywheel counterbore. Install clutch cover-to-flywheel capscrews with their lock washers. Tighten capscrews a turn or two at a time, in rotation, so cover will not be cocked and forced into flywheel pilot by the tightening of the screws.

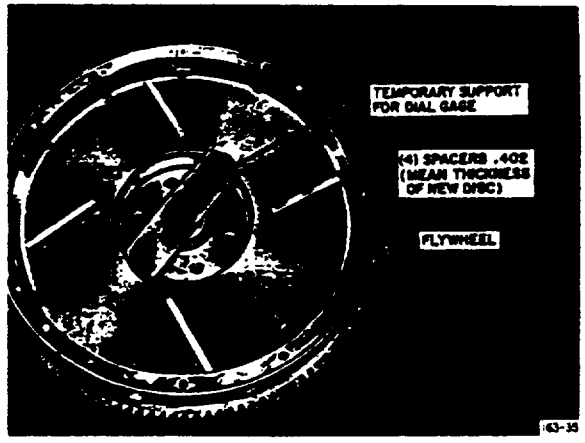


Figure 5-26. Clutch Lever Adjustment Spacer Arrangement in Flywheel

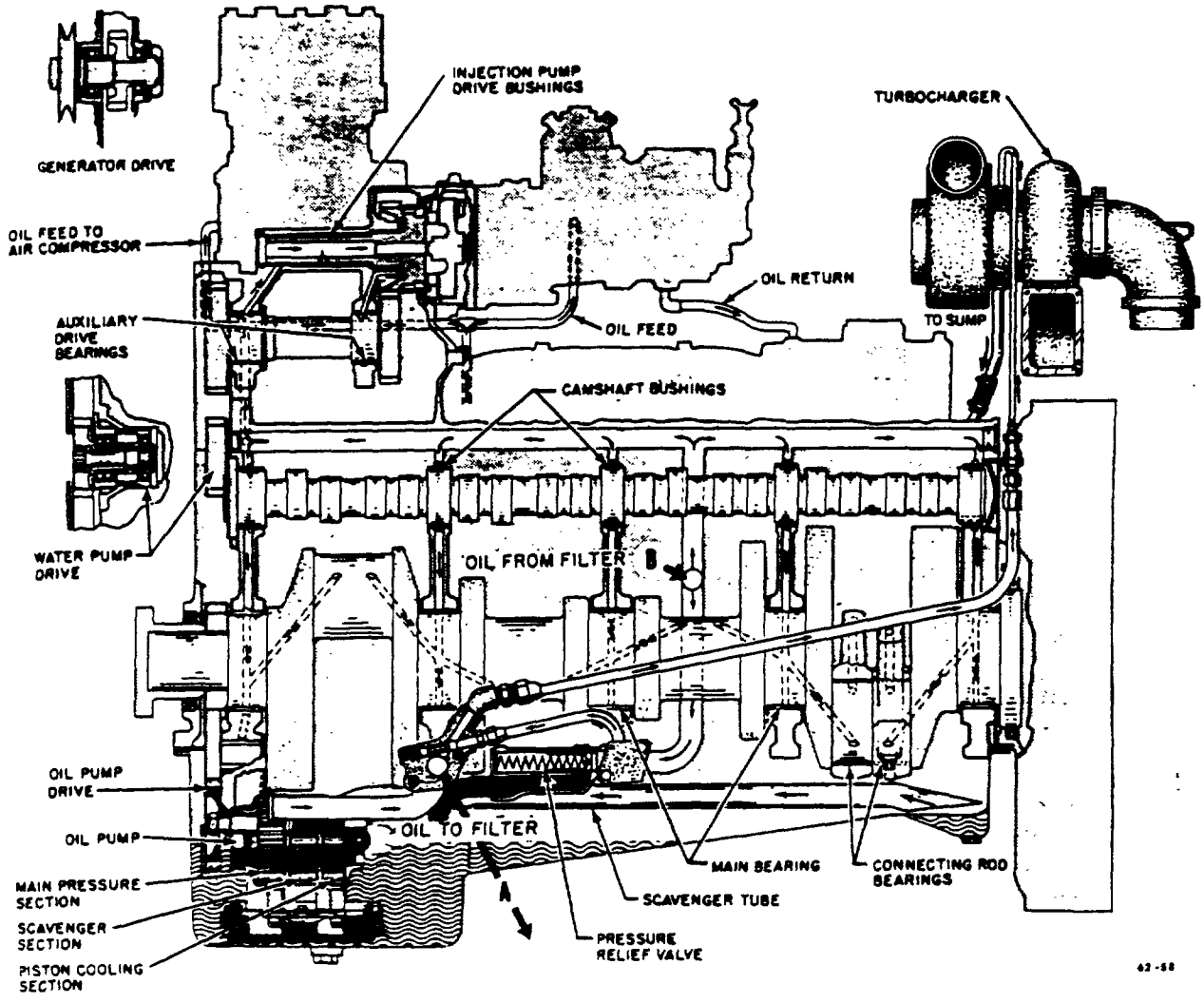


Figure 3-184. Lubrication System END T864 Series

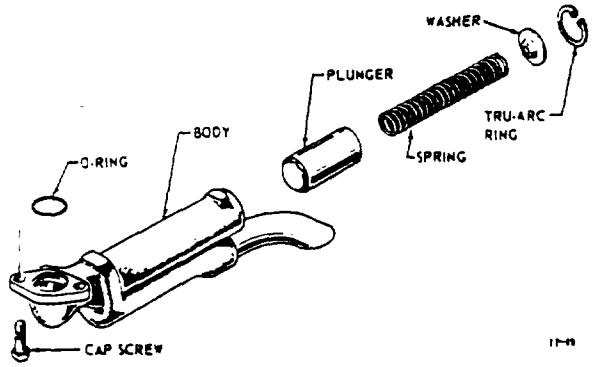


Figure 3-185. Pressure Relief Valve Assembly END864 Series

Installation

Position a new O-ring on the oil pressure relief valve housing flange and install housing onto cylinder block. See Figure 3-186. Position discharge spout away from center of cylinder block then torque capscrews. This will provide sufficient clearance between connecting rod and oil pressure relief valve housing assembly.

OIL PAN EXCEPT END475 SERIES

Inspection

Inspect oil pan for dents, cracks and condition of flange, bolt holes for elongation and baffle for security. Inspect drain hole for condition of threads.

Installation

Position gasket on oil pan and position oil pan on cylinder block. Install and tighten oil pan retaining capscrews evenly to prevent oil leakage.

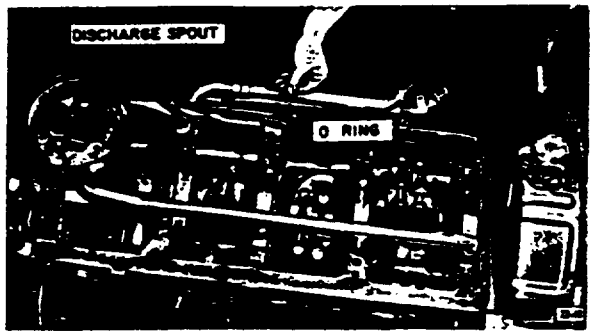


Figure 3-186. Oil Pressure Relief Valve Installed END864 Series

OIL PAN END475 SERIES

Description

Oil pan is a machined casting and is provided with a sheet metal cylindrical oil screen. The oil screen has a crimped section for proper positioning in the oil pan.

Inspection

Inspect oil pan for dents, cracks, condition of flanges, bolt holes for elongation and condition of threads. Check oil pressure relief valve mounting pad for flatness and condition of threaded holes. Check oil passages to ensure they are not obstructed. Check oil screen assembly for holes, cracks and condition of welds. Check screen cover section to ensure pick up oil tube hole is not damaged and mounting surface is clean.

Installation

Position spacer on stud in center of oil pan. Install screen assembly over stud and locate crimped section of screen on lug to properly position cover for oil pick up tube. Install lockwasher and nut to secure screen assembly. Position oil baffle in pan and secure in place with capscrews and lockwashers. Position new gasket on oil pan flange and new O-ring on pressure relief valve tube. Install new felt washer on oil pick up tube. Position oil pan on crankcase and secure with capscrews. Torque capscrews evenly to prevent oil leakage.

CYLINDER HEAD STUDS

Inspection

Check cylinder head studs for condition of threads, and straightness of shank.

Installation

Apply a light coat of lubricating oil to the threads of the studs and install them in the cylinder block finger tight.

NOTE

END475 cylinder studs are installed with the shoulder fully seated.

Locate the longer studs at the corners on the push rod hole side of the cylinder block.

NOTE

On END864 the longer studs are positioned at the rocker arm shaft bracket locations.

CYLINDER HEAD INSTALLATION

Place cylinder head gasket over studs on cylinder block. Ensure that all passages are open and not blocked by gasket. Ensure O-rings are properly positioned. Cylinder gaskets are precoated, no soaking, coating or sealants are required. Use gaskets as received.

NOTE

If desired, apply a light coating of Permatex to the entire outer edge of the gasket to seal the corbestos layer which may be affected by lube oil or fuel.

Position cylinder head over studs and onto cylinder block. See Figure 3-187. Ensure no foreign material is in cylinder.

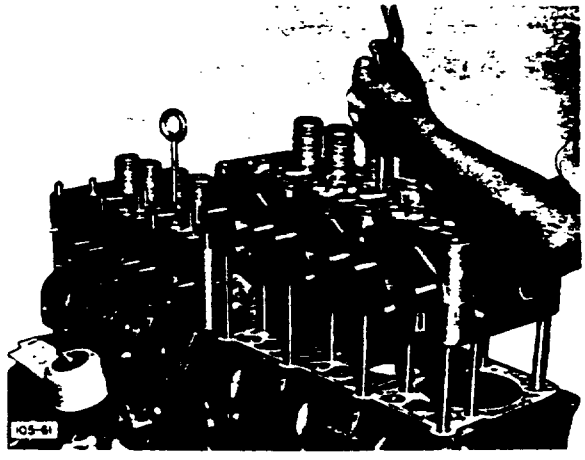


Figure 3-187. Installing Cylinder Head

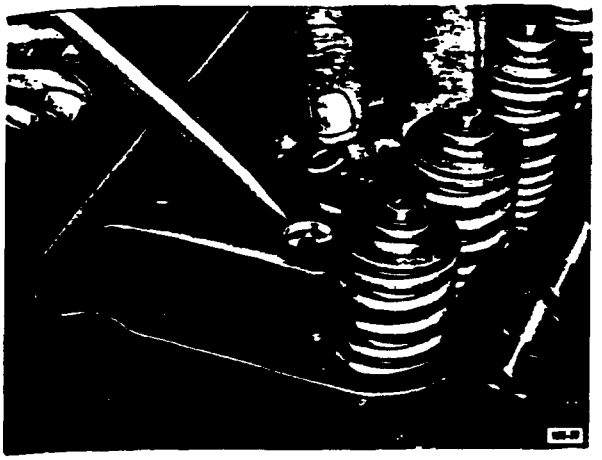


Figure 3-197. Installing Rocker Arm Bracket O-ring END465, 673, T, and 711 Series

NOTE

The END475 uses a paper type gasket between the rocker arm shaft bracket and the cylinder head.

Installation

Install rocker arm assembly to cylinder head ensuring rocker arm bracket with oil hole is over the O-ring oil seal.

Install rocker arm bracket capscrews and tighten to proper torque.

NOTE

On END475 install hollow oil transfer bolts at the rocker arm bracket locations, also be sure valve stem wear caps are installed.

To set the rocker arm static (cold) clearance, position No. 1 cylinder piston on TDC of the compression stroke. Timing indicator on flywheel must indicate TDC.

Adjust inlet and exhaust valve clearance in firing order. Each adjustment from No. 1 piston TDC setting is 1/3 of a turn on the crankshaft from one adjustment to the next. Two complete revolutions of the crankshaft are required to make all valve clearance adjustments.

NOTE

On END, T, 864 each adjustment from No. 1 piston setting is 1/4 of a turn on the crankshaft from one adjustment to the next.

WATER OUTLET MANIFOLD

Inspection

Inspect water outlet manifold for restrictions. Check mounting flanges for cracks and straightness.

On END, T, 864 check the thermostat seal in the water outlet fitting for looseness and erosion.

Installation

Place new hose and clamps between front half and rear half of the water outlet manifold or tube and O-ring, if applicable. Place new gaskets between water manifold and cylinder head. Install and tighten attaching capscrews to the proper torque. Position hoses and hose clamps as applicable.

Install thermostat and by-pass fitting and thermostat housing cover and seal as applicable. See Figures 3-198, 3-199, and 3-200.

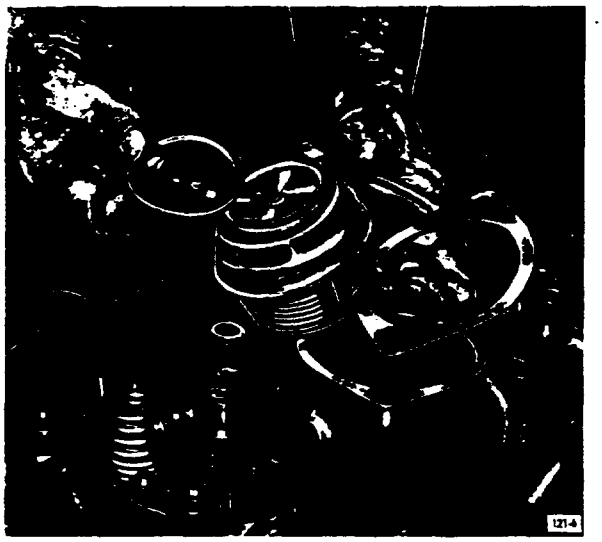


Figure 3-198. Installing Thermostat END465 Series

On END, T, 864 install new thermostat seal if old one was found unserviceable. See Figure 3-201.

INJECTION PUMP INSTALLATION (PSJ-PSM) END465, 673, T, 711 SERIES

1. Bar engine in normal direction of rotation until No. 1 cylinder is on compression stroke and flywheel timing mark indicates correct number of degrees BTC. recommended on pump data plate.

Installation

Place new gaskets between intake manifold and cylinder head. Install and tighten attaching capscrews to the proper torque. On END864 position O-rings and install inlet manifold cross-over tubes and hose. See Figure 3-209.

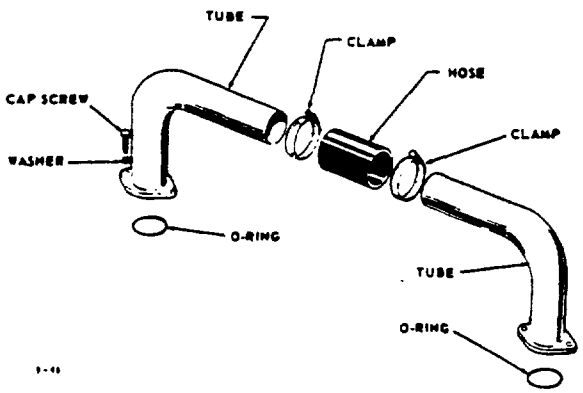


Figure 3-209. Intake Manifold Cross Over Tube END864

EXHAUST MANIFOLD

Inspection

Inspect the exhaust manifold for restrictions. Check mounting flanges for erosion, cracks and straightness.

Installation

Place new gaskets between exhaust manifold and cylinder head. Install and tighten the attaching washers and nuts or capscrews, as applicable, to the proper torque.

ROCKER ARM COVERS

Inspection

Inspect rocker arm covers for cleanliness, dents and straightness of flange. Check breather in cover, if applicable, to be sure it is not plugged.

Installation

Cement new gasket to mounting flange of rocker arm cover.

Position cover over rocker arms, install and torque cover retaining capscrews or nuts as applicable.

ENGINE BREAK-IN PROCEDURE AFTER OVERHAUL OR REBUILD

Comparative tests and careful review of engine break-in methods have proven that a short run under full-load is substantially more effective than the light or no-load slow speed increase type of break-in. Compatibility between the critical components (pistons, rings and bores) is greatly improved by raising engine speed and applying full-load immediately after warm-up.

Use the recommended type and grade engine oil and fuel as required for usual operation of the vehicle.

Immediately prior to initial starting of the engine, oil galleries and filters are to be primed preferably by means of a pressure tank.

Check the air intake system to ensure all joints are tight and the filter element and system are clean.

After break-in procedure is complete, recheck cylinder head stud nut torque and valve clearance adjustment.

NOTE

Torque cylinder head studs while engine is at operating temperature. Back each nut off individually and then tighten to the recommended torque.

When the vehicle is put into service, treat the engine as though it were new and follow the "Breaking in a New Vehicle" instructions listed in the Operation Manual.

Where a dynamometer is available, the break-in schedule is as follows:

Minutes	RPM	LOAD
15	1000	Warm-up (no more than 1/4 load)
30	1400	Full
30	2100	Full
15		Check out

CAUTION

When using chassis dynamometer, provide fans for cooling rear tires at roller contact area.

NOTE

Current production auxiliary drive gears do not have timing marks and do not have to be timed.

Oil Pump Drive and Compressor Drive Coupling Gear

Oil pump drive and compressor drive coupling gear is designed with the coupling gear on one end and the oil pump drive gear on the other.

Inspect gears for wear pattern and cracked, chipped or broken teeth. See Figure 22. Install locating key in keyway of auxiliary shaft. Align slot in oil pump drive gear end of coupling and install gear on shaft. Install coupling washer and nut. Torque nut. Install compressor oil transfer tube in end of auxiliary driveshaft.

Tachometer Drive Assembly

Inspect tachometer shaft for wear and gear for chipped, cracked or broken gear teeth. Check housing bore for wear and flange for straightness and condition of holes.

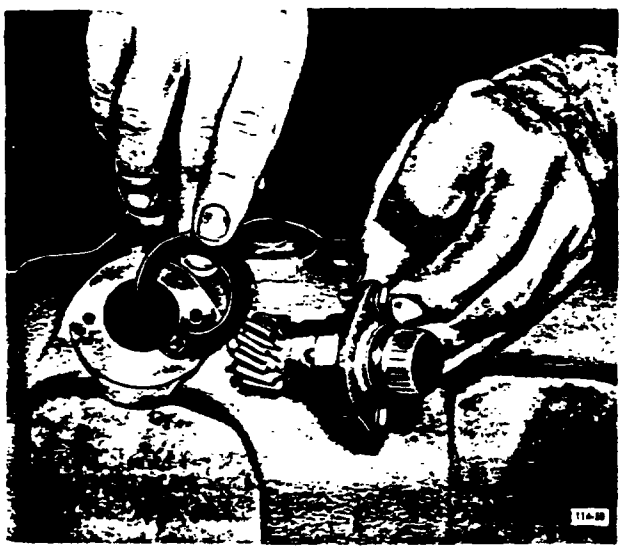


Figure 23. Installing Tachometer Drive Assembly

Lubricate tachometer shaft and gear and position in tachometer housing.

Install tachometer drive assembly and gasket on auxiliary drive housing. See Figure 23.

Injection Pump Drive Assembly

NOTE

Current production turbocharged engines use an aluminum injection pump drive housing and does not use ball bearings or bushings.

Injection pump drive assembly consists of a shaft with integral flange and tangs, a front and rear ball bearing positioned by a spacer and retained in the housing by a nut and cotter key. See Figure 24.

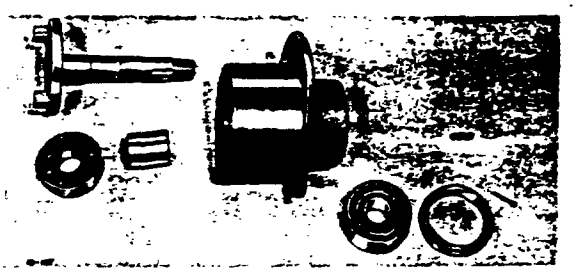


Figure 24. Injection Pump Drive Assembly

Inspect shaft for condition of flange and tangs. Check bearing locations for wear and galling. Check keyway slot and threads for condition. Inspect bearings for condition and free rotation. Check housing for straightness of flange, condition of bearing locations, holes and threads.

Position housing on bench with small end up. Coat bearing O.D. and recess lightly with Loctite grade B. Do not allow Loctite to enter bearing races. Install front bearing in housing with closed side up and tap into position with a suitable drift. Install bearing retaining nut; torque and lock in position with a cotter key. Allow Loctite to harden at least 72 hours at 72° F. Moderate heat may be used to accelerate hardening.

Installation

Position crankshaft pulley and vibration damper on crankshaft hub and secure with hardened washers and capscrews. Where separate pulley and damper parts are used, torque capscrews.

OIL PRESSURE CONTROL VALVE ASSEMBLY (Anti-lag valve not used with Airesearch turbocharger)

Description

Oil pressure control valve is a machined casting containing oil passages and spring-loaded valves for oil pressure control and direction. See Figure 55.

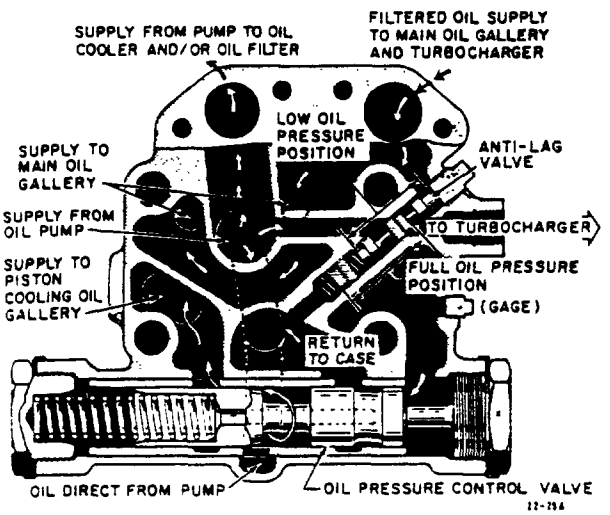


Figure 55. Oil Pressure Control Valve

The assembly is mounted externally on the cylinder block and aligns with the oil passage directly from the oil pump.

A portion of this oil is directed to the turbocharger to insure immediate and positive lubrication when starting the engine. After the engine is running, however, the passage is closed off by the anti-lag valve and filtered oil is channeled to the turbocharger.

The oil is transferred by an external line from the pressure regulator to the oil cooler. After passing through the oil cooler, an external line transfers the oil to the oil filter and the oil filter outlet is connected by an external line to the oil pressure regulator.

The cooled and filtered oil entering the regulator is directed to the engine oil gallery for engine lubrication and also acts upon the two valves located in the housing. The oil acts upon the anti-lag valve and closes the passage which had admitted oil to the turbocharger from the oil pump and now directs filtered oil to the turbocharger. An anti-drainback valve is in the turbocharger lubricating oil line to prevent oil drainback during layovers.

The oil also acts upon the pressure regulator valve and allows oil, directly from the oil pump, for piston cooling and permits excess oil to drain back to the crankcase.

Oil for piston cooling system is direct from the oil pump and is only effective at engine rpm above idle.

Inspection

Inspect the oil pressure control valve housing for flatness. Be sure all oil passages are clean and not obstructed. Check anti-lag valve and pressure control valve springs for wear and proper compression pressure. Check anti-lag valve for wear, condition, and for freedom of movement in housing.

Check pressure control valve for wear, condition and freedom of movement in housing bushing. Be sure oil passages are clean and not obstructed.

Check pressure control valve bushing in housing to be sure notch on bushing and housing are lined up indicating oil slots are in proper position.

Assembly

Install the anti-lag valve spring in the housing. Lubricate and install anti-lag valve. Be sure pilot on valve enters hole in spring. Apply a light coat of sealant to the threads of the pipe plug and install in housing to retain anti-lag valve.

Position washer on oil pressure control valve retainer cap. Install cap into housing and bend tab to lock cap. Lubricate and install pressure control valve and pressure control valve spring.

Position washer on oil pressure control valve spring retainer cap and install cap into housing. Torque cap and bend tab to lock cap.

Apply a light coat of sealant to the threads of the two pipe plugs and install in housing.

Install protective covers on oil IN and OUT fittings.

Installation

Position a new gasket on the cylinder block and install the oil pressure control valve

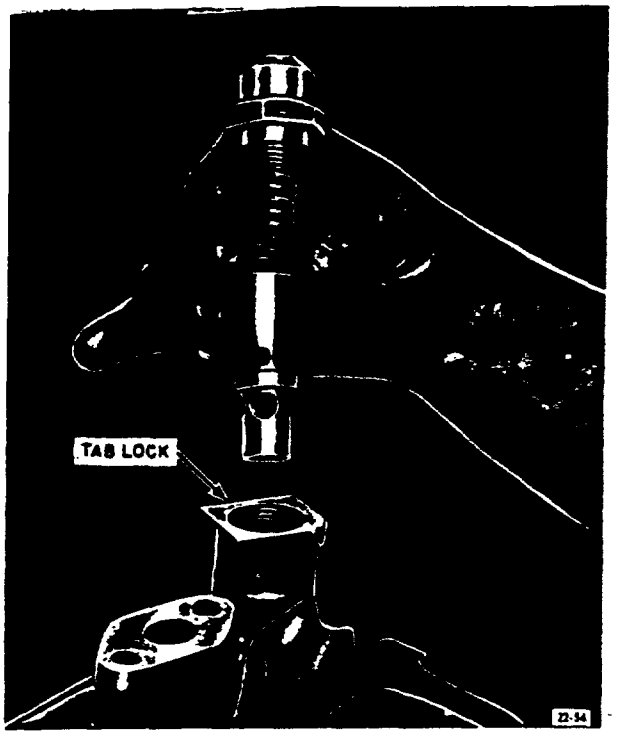


Figure 59. Installing Oil Pump Pressure Relief Valve Plunger

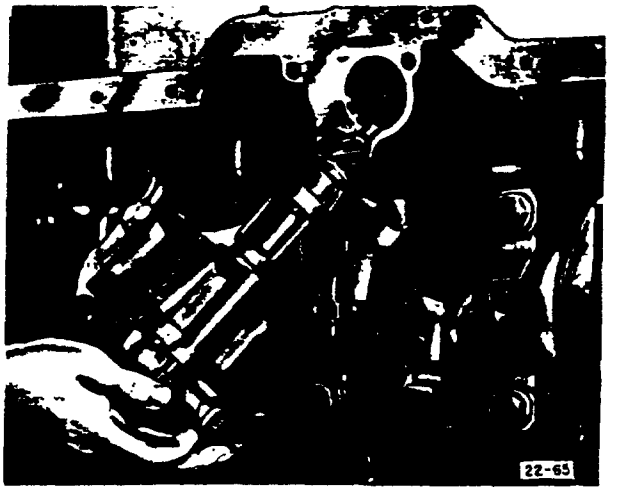


Figure 60. Installing Oil Pump

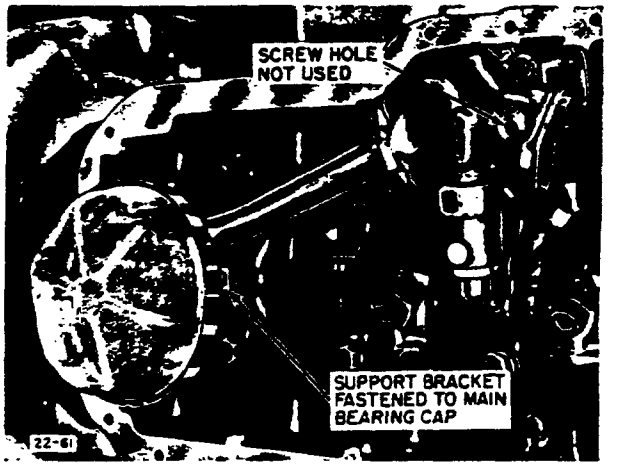


Figure 61. Oil Pump Pick-up Pipe Installation

Check oil pick-up pipe and shield assembly for cleanliness and lack of obstruction. Place a gasket on pump flange and install oil pick-up line. Torque screws and lockwire together. Install oil screen, support and inlet pipe. See Figure 61. See Figures 62, 63 and 64 for lubrication system.

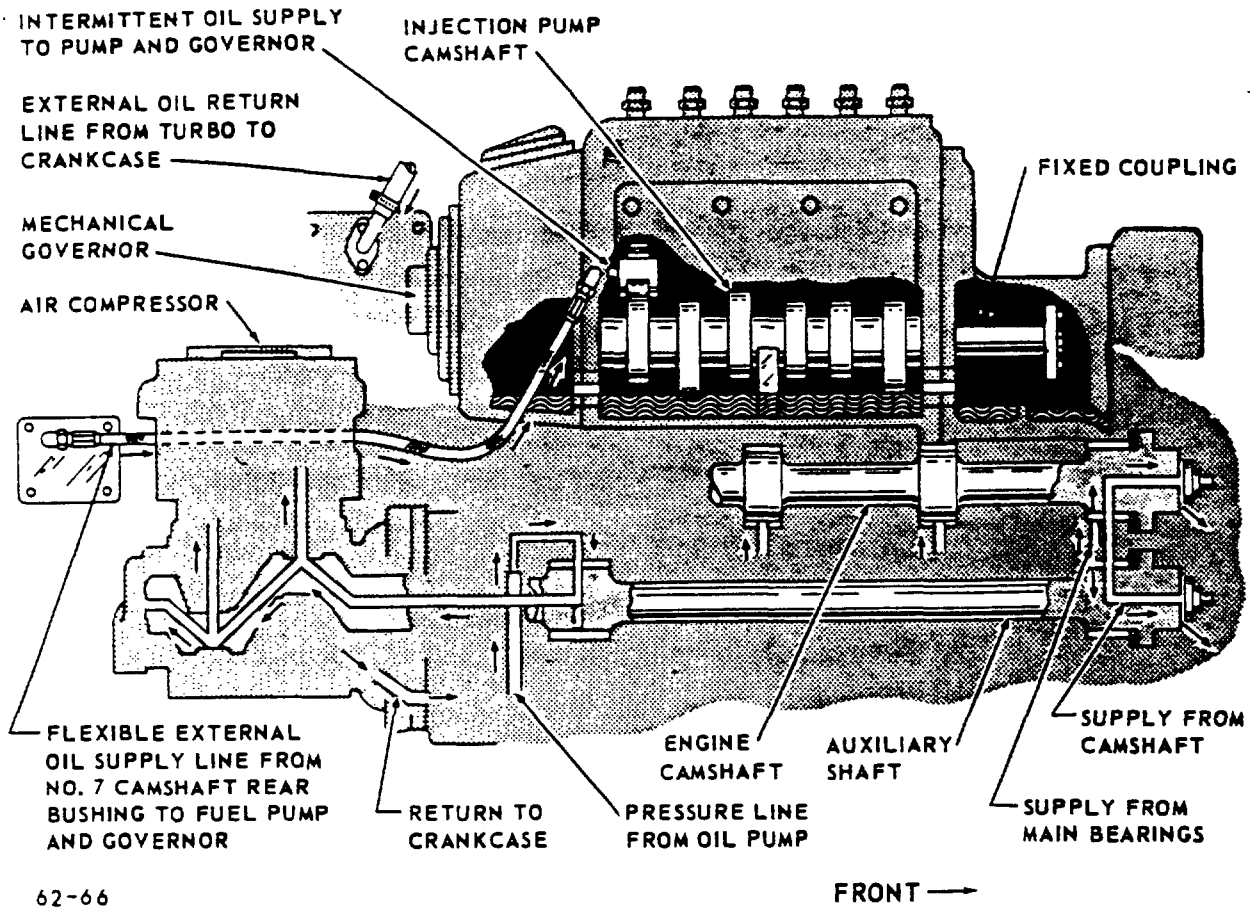


Figure 64. Auxiliary Drive and Injection Pump Lubrication

OIL PAN

Inspection

Inspect oil pan for dents, cracks and condition of flange, bolt holes for elongation and baffle for security. Inspect drain hole for condition of threads.

Installation

Position gasket on oil pan and position oil pan on cylinder block. Install and tighten oil pan retaining capscrews evenly to prevent oil leakage.

CYLINDER HEAD STUDS

Inspection

Check cylinder head studs for condition of threads, and straightness of shank.

Installation

Apply a light coat of lubricating oil to threads of studs and install them in cylinder block finger-tight, then back off 1/3 turn.

CYLINDER HEAD INSTALLATION

CAUTION

New cylinder head gaskets and fire rings must be installed each time cylinder heads are removed.

Place cylinder head gasket over studs on cylinder block. Be sure that all passages are open and not blocked by gasket. Make sure fire rings are properly positioned. Cylinder gaskets are precoated; no soaking, coating or sealants are required. Use gaskets as received.

Position cylinder head over studs and gently onto cylinder block. See Figure 65. Be sure no foreign material is in cylinder.

Install cylinder head stud washers and nuts. Torque cylinder stud nuts in progressive steps of 50 lb. ft. using proper tightening sequence. See Figure 66.

To set the rocker arm static (cold) clearance, position No. 1 cylinder piston on TDC of the compression stroke. Timing indicator on flywheel must indicate TDC.

Adjust inlet and exhaust valve clearance in firing order. Each adjustment from No. 1 piston TDC setting is 1/3 of a turn on the crankshaft from one adjustment to the next. Two complete revolutions of the crankshaft are required to make all valve clearance adjustments.

WATER OUTLET MANIFOLD

Inspection

Inspect water outlet manifold for restrictions. Check mounting flanges for cracks and straightness.

Installation

Place new hose and clamps between front half and rear half of the water outlet manifold. Place new gaskets between water manifold and cylinder head. Install and tighten attaching capscrews to the proper torque. Position hoses and hose clamps as applicable.

Install thermostat and by-pass fitting and thermostat housing cover and seal as applicable. See Figure 69.

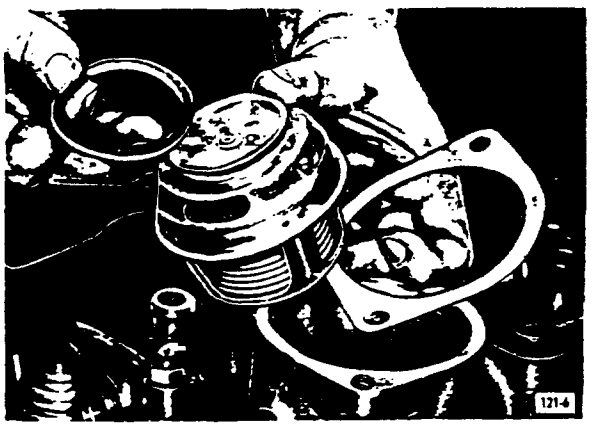


Figure 69. Installing Thermostat

WATER PUMP

Description

The water pump is a centrifugal-rotor type, V-belt driven from the crankshaft. The pump cover contains the grease cavity and provisions for two, single row, ball bearings which support the shaft. The bearings are sealed on one side to retain grease. A vent fitting replaces the usual grease fitting because the initial pack of grease, 1/3 full, should suffice for the life of the pump. A cartridge-type water seal with synthetic rubber bellows and carbon ring form an effective water-tight seal.

The housing, which comprises the volute (rotor casing) and water outlet to the engine is also the pump mounting.

It is usually more economical to obtain a rebuilt exchange water pump than to overhaul the old one. Contact your Mack Branch or Distributor for rebuilt exchange water pumps.

INJECTION PUMP INSTALLATION

1. Bar engine in normal direction of rotation until No. 1 cylinder is on compression stroke and flywheel timing mark indicates correct number of degrees BTC recommended on valve cover escutcheon plate. The injection pump driveshaft flange lugs should now be in a horizontal plane and indexing pin hole at 4 o'clock position, looking at face of shaft flange.

2. Grease front (non-counterbored) face of coupling and mount on pump driveshaft flange with long end of offset indexing pin pointing rearward and center the coupling ring laterally.

3. Remove pump adapter inspection hole cover.

4. Rotate pump coupling driven flange until lugs are in a vertical plane and indexing hole is at 7 o'clock position, looking from drive end of pump. See Figure 70.

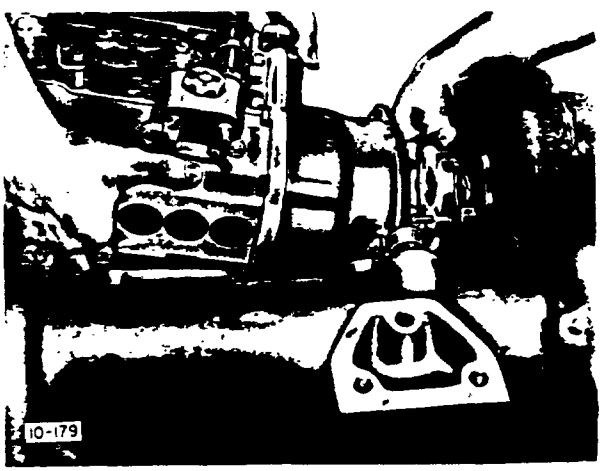


Figure 70. Installing Injection Pump

AIR COMPRESSOR

Inspection

Inspect air compressor flange for cracks, straightness and condition of holes. Check coupling teeth and insure shaft nut is tight and tab is bent to lock nut.

Installation - See Figure 72

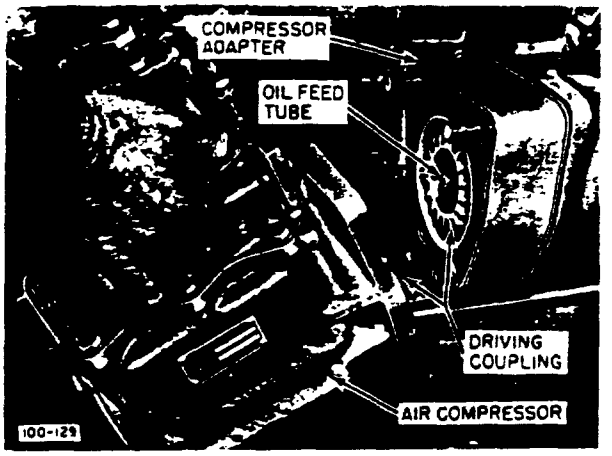


Figure 72. Installing Air Compressor

The air compressor is "phased" or "timed" to the engine. A tooth in the bore of the fiber coupling is shaved down to clear a pin in the drive coupling. The compressor can be installed only one way. If difficulty is experienced, recheck to insure coupling and drive are in proper mesh.

Current production engines do not require phasing or timing. The pin has been omitted from the drive coupling.

Be sure oil transfer tube is tight in end of auxiliary driveshaft.

Position air compressor adapter ring, if used, into auxiliary housing counterbore. Place gasket on air compressor and position on auxiliary housing. Install and torque air compressor retaining capscrews or nuts.

WARNING

Recheck auxiliary shaft end float after installing air compressor or vacuum pump.

FUEL INJECTION LINES, HIGH PRESSURE

Description

Fuel injection lines are seamless cold-drawn high tensile steel. All lines on one engine are of identical length and inside diameter.

Inspection

Inspect fuel injection line for chafing, dents, nicks or sharp bends. Check fittings, seat and threads for condition. Check lines to be sure they are not restricted.

Installation

Install fuel injection nozzles. Install fuel injection lines and be sure brackets are properly positioned to prevent lines from chafing.

The lines should fit without difficulty if they have not been changed around. NEVER BEND THE LINES TO MAKE THEM FIT.

Torque fuel injection lines at injection nozzles and pump locations. Torque injection line brackets.

INLET MANIFOLD

Inspection

Inspect inlet manifold for restrictions. Check mounting flanges for erosion, cracks and straightness.

Installation

Place new gaskets between inlet manifold and cylinder head. Install and tighten attaching capscrews to the proper torque.

EXHAUST MANIFOLD

Inspection

Inspect the exhaust manifold for restrictions. Check mounting flanges for erosion, cracks and straightness.

Installation

Place new gaskets between exhaust manifold and cylinder head. Install and tighten the attaching washers and nuts to the proper torque.

ROCKER ARM COVERS

Inspection

Inspect rocker arm covers for cleanliness, dents and straightness of flange. Check breather in cover, if applicable, to be sure it is not plugged.

Installation

Cement new gasket to mounting flange of rocker arm cover.

Position cover over rocker arms; install and torque cover retaining capscrews or nuts as applicable.

TURBOCHARGER (Refer to Page 3-23 for turbocharger information)

TURBOCHARGER TROUBLE SHOOTING

Frequently turbochargers are removed and returned for repair exchange unnecessarily as factory inspection reveals they are still serviceable and repair is not necessary. If turbocharger malfunction is suspected, follow these inspections and refer to trouble shooting chart at end of bulletin.

CAUTION

Do not place hands or fingers near turbocharger inlet while engine is running. Vacuum can be created which could draw fingers into compressor blading causing injury.

PROCEDURE

I. NOISE CHECK

Start engine and check for unusual noise or vibration from turbocharger. This will indicate out of balance, rubbing or damage to compressor or turbine wheels. If rubbing noise is evident, shut down engine immediately.

NOTE

Remove compressor housing and/or turbine housing. If any sign of turbine wheel or compressor wheel rub is evident, the turbocharger will have to be removed, cleaned, repaired or exchanged, as necessary.

II. LEAKAGE CHECKS

If no noise is evident, perform the following inspections:

With Engine Running:

1. Check for leaks in air inlet system from air cleaner to inlet manifold. Use light oil squirted from oil can or soap suds on joints to detect suction or pressure leaks. Soap suds can be used to detect porous hose or light application of starting fluid spray which causes engine speed to rise when applied against porous or leaking hose or connections. Check all hoses and tubing for chafing, holes or sliding out of place.

2. Check exhaust manifold for cracks, leaks and missing, loose or blown gaskets.

3. Check turbocharger lubricating oil inlet and outlet lines and fittings for chafing, pinching or leaking.

Shut Engine Down and Perform the following:

1. Be sure all bolts, clamps and connections are tight and intake manifold gaskets are in proper location and tight.

2. Check to be sure exhaust manifold and turbocharger mountings are tight.

3. Perform the following checks if the turbocharger compressor shows evidence of oil leakage.

a) Wet Inlet: Check air cleaner and/or air compressor inlet line if compressor inlet is tied into engine air inlet system.

b) Wet Outlet: Check back of compressor wheel and in crossover tube to intake manifold.

If oil wetting is found, clean compressor, compressor wheel and crossover tube. Run again under operating conditions, inspect, if no leakage is evidenced, check air compressor for oil passing or engine oil difficulties other than the turbocharger.

III. PRESSURE CHECKS

Install an oil pressure gage in the turbocharger oil inlet line and a pressure gage in the inlet manifold and perform the following checks. See Figure 1 for typical gage locations. Start engine.

1. Check turbocharger oil inlet pressure for minimum of 10 psi with engine at idle rpm.

2. Recheck items 1, 2, 3 and 4 as in Section II with the engine running.

3. Inspect oil drain line to be sure it is not clogged or restricted.

4. Inspect oil supply line for restriction, deterioration or possibility of leaking under pressure. Be sure check valve is working properly and not restricted.

5. Inspect turbocharger mounting pad, on exhaust manifold, for erosion, flatness and to be sure old gasket is removed.

6. Place new gasket on exhaust manifold, position turbocharger and install attaching bolts.

7. Connect compressor inlet and outlet piping. Check to be sure all clamps and bolts are tight. Be sure piping is not producing strain on compressor cover.

8. Connect oil inlet line to turbocharger.

9. Crank the engine, without firing, until a steady flow of oil is noted coming from the oil drain outlet of the turbocharger or charge the system from an external pressurized oil source.

10. Stop cranking engine or charging system and connect oil drain line to engine. Be sure drain line slopes downward throughout its length with no sharp bends or kinks.

This guide is to acquaint the mechanic with troubles peculiar to turbochargers. Common sense and good shop practices are to be exercised. Check out the easier and more probable causes first, then proceed to the more complicated or time consuming items.

Trouble and Symptoms	Probable Causes Check causes given in sequence shown.
Noisy	9, 10, 11, 12, 13, 14, 15, 17, 20, 23, 25, 26, 27, 28, 29, 30
Low turbocharger speed	1, 3, 4, 7, 8, 13, 15, 16, 20, 23, 25, 26, 27, 29, 30, 34
Low turbocharger pressure	1, 3, 5, 7, 14, 11, 12, 13, 15, 16, 23
Cracked turbocharger housings or flanges	1, 3, 5, 7, 30, 11, 12, 13, 15, 16, 19, 20, 23, 26, 27, 28, 31, 32, 33
Engine lacks power	
Black smoke	1, 2, 3, 5, 16, 24, 7, 19, 15
Blue smoke	24, 2, 7, 4, 22, 34
Lubrication oil consumption excessive	19, 21, 22, 3, 1, 5, 18, 24, 25, 34
Lubrication oil leakage	21, 19, 18, 22, 24, 25, 34
Insufficient lubrication	19, 21, 17, 31
Oil in Air Inlet System	
Before turbocharger	1, 2, 3, 4, 5, 7, 18, 19, 34
After turbocharger	1, 2, 3, 4, 7, 5, 22, 24, 25, 28, 34
Oil in Exhaust System	
Before turbocharger	12
After turbocharger	22, 24, 25
Unbalance of rotating assembly	25, 23, 9, 3, 11, 12, 13, 18, 19, 20
Drag or bind in rotating assembly	9, 26, 27, 28, 30, 25, 18, 19, 20, 17, 13 22, 29, 11, 12, 31, 32, 33, 34
Damaged turbine wheel	12, 13, 15, 25, 27, 28, 30, 32, 33
Damaged compressor impeller	6, 9, 11, 13, 25, 26, 27, 28, 30, 33
Worn bearings or journals	17, 18, 19, 20, 21, 26, 27, 28, 30, 31, 32, 33

76

MACK
The Greatest Name in Trucks

MACK TRUCKS, INC.
one of The Signal Companies

TS442		10/67	10M
TS442	REV.	8/69	10M
TS442	REV.	5/71	10M
TS442	REP.	12/72	10M
TS442	REV.	8/75	10M

Printed in U. S. A.

Core Exchange -
Schwitzer or Holset Turbocharger

1. Remove lubricating oil inlet and outlet lines.

2. Loosen clamp on compressor housing and move housing away from core assembly.

3. Support core assembly and loosen clamp on turbine housing and remove core assembly. Holset uses capscrews and washers to secure core assembly.

4. Install core assembly in reverse manner. Also be sure to prime turbocharger lubricating system. Refer to Installation Procedure.

Turbocharger Exchange - Schwitzer, AiResearch or Holset Turbochargers

1. Remove lubricating oil inlet and outlet lines.

2. Remove air inlet duct from compressor housing.

3. Remove exhaust pipe from turbine housing.

4. Remove turbocharger retaining bolts and remove turbocharger from engine exhaust manifold.

Installation Procedure

Use the following steps as a guide when installing turbocharger to engine.

1. Inspect air intake system for cleanliness, leakage and foreign material.

2. Inspect exhaust manifold for leakage and foreign matter.

3. Inspect oil drain line to be sure it is not clogged or restricted.

4. Inspect oil supply line for restriction, deterioration or possibility of leaking under pressure. Be sure check valve is working properly and not restricted.

5. Inspect turbocharger mounting pad, on exhaust manifold, for erosion, flatness and to be sure old gasket is removed.

6. Place new gasket on exhaust manifold, position turbocharger and install attaching bolts.

7. Connect compressor inlet and outlet piping. Check to be sure all clamps and bolts are tight. Be sure piping is not producing strain on compressor cover.

8. Connect oil inlet line to turbocharger.

9. Crank the engine, without firing, until a steady flow of oil is noted coming from the oil drain outlet of the turbocharger or charge the system from an external pressurized oil source.

10. Stop cranking engine or charging system and connect oil drain line to engine. Be sure drain line slopes downward throughout its length with no sharp bends or kinks.

Turbocharger Overhaul Procedure

NOTE

Clean exterior of turbocharger with a pressure spray of cleaning solvent and air blow dry before starting disassembly. Due to close tolerances and extremely high rpm of the turbocharger it is of utmost importance to have a clean work area.

1. Mark alignment of turbine housing and compressor housing for correct alignment with bearing housing at reassembly. Use a suitable center punch or small chisel.

2. Remove Vee clamp and separate compressor housing from bearing housing. Use care to prevent damage to compressor wheel.

3. Remove O-ring from groove in bearing housing if used.

4. Position turbocharger in a vise and mount a dial indicator with contact point on side of compressor wheel retaining nut.

5. Move compressor wheel away from indicator while pressing turbine wheel in opposite direction.

6. Zero dial indicator and check total side play of shaft by pressing compressor wheel toward indicator and turbine wheel in opposite direction. If measured movement exceeds maximum limit the turbocharger must be overhauled.

7. Check chaft end float using a dial indicator with tip of indicator on end of shaft. Move shaft toward dial indicator and zero dial in-

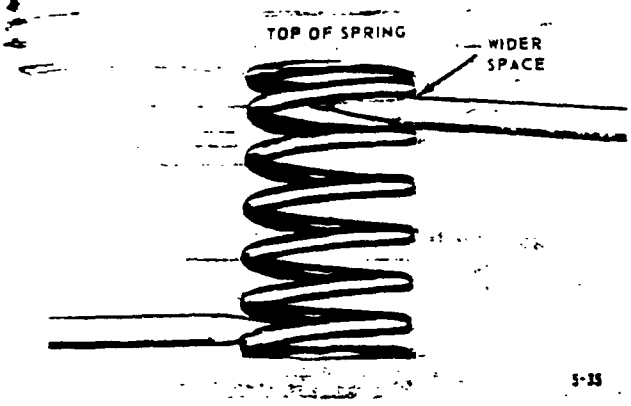


Figure 2-48. Valve Spring

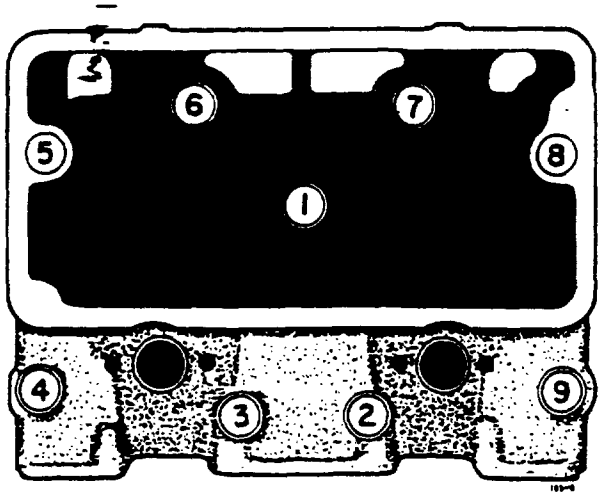


Figure 2-50. Torquing Sequence

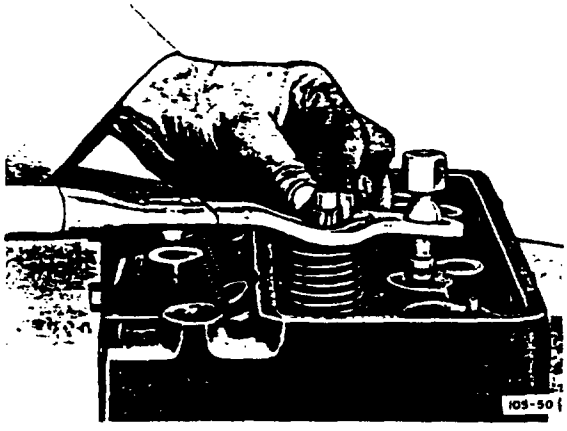


Figure 2-49. Installing Valve Keys

Installing Cylinder Heads

New cylinder head gaskets are installed on the cylinder block with "Top" mark up. Check cylinder head studs for secureness in the block; also threads for damage that may cause binding of the stud nuts. Fit cylinder heads over studs lowering on to cylinder head gasket carefully to avoid damage. Install cylinder head stud washers and nuts. Torque nuts in sequence shown with a calibrated torque wrench in progressive steps of 50, 100 and finally 140 lb. ft. (Stud threads oiled). See Figure 2-50.

Install the two water connection flanges, with gaskets, to cylinder head (connecting heads together to permit cooling water circulation through the three cylinder heads), and install thermostat housing (outlet) and gasket to the front head. A blank plate and gasket are used at the rear head.

Valve Rocker Arm and Shaft Assembly

The valve rocker arm features a bushing. When the bushing is installed, the split must locate on the horizontal plane and face the slipper side of the arm. See Figure 2-51.

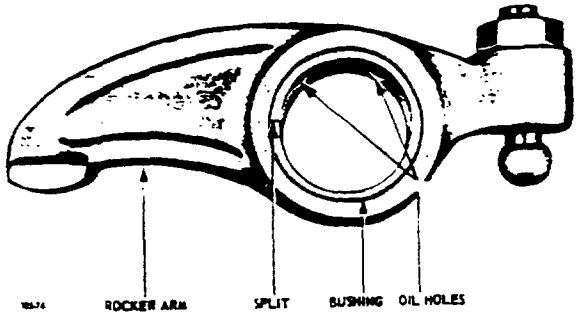


Figure 2-51. Rocker Arm Assembly

Press the bushing in so that it will come flush with the side of the hub which contacts the rocker arm shaft bracket. Two oil holes must be drilled in the bushing. They must be in alignment with the two oil holes provided on top of the arm to feed the slipper and the rocker arm to pushrod adjusting screw with lube oil. Ream bushing I. D. 0.8661 to 0.8669 in., to allow for proper running clearance with a new rocker arm shaft diameter. Check shaft O.D. at unworn area for size, before reaming new bushings to be used with old shaft. Running clearance, 0.0005 to 0.0015 in.

The valve rocker arm shaft is hollow. Two large holes are drilled through the shaft vertically, at locations where the bracket-to-cylinder head screws are installed. Four positions on the shaft are drilled through the shaft from one side to the other, on a horizontal plane. This provides eight oil feed holes, two for each of four rocker arms. They feed the bushing with lube oil at the 3 and 9 o'clock positions.

The valve rocker arm and shaft assembly must be installed only after the cylinder heads have been properly torqued down.

The valve lifters must be installed with the camshaft in place. The pushrods must then be installed. See Figure 2-52.

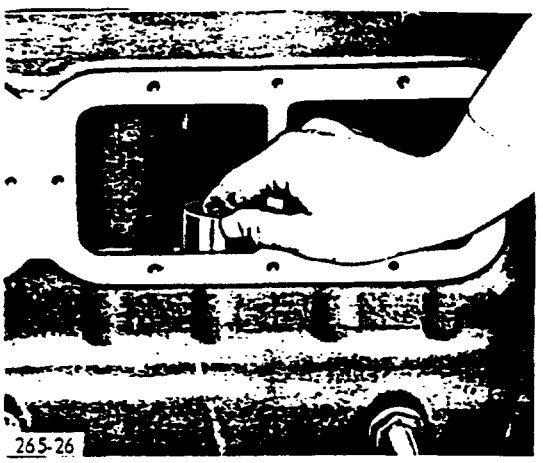


Figure 2-52. Installing Valve Lifter

The rocker arms, shaft, springs and brackets are assembled and secured at each end with large hex head type plugs. The two bracket-to-cylinder head bolts must also be in place before installing the assembly to the head. The bolts are drilled up through the center, and a feed hole drilled on side of the bolt locates inside the rocker arm shaft, on the assembly, to admit lube oil which originates (under pressure) from a passage directed to the bottom of the tapped hole (in the cylinder head) to feed the bracket bolt.

A heavy paper disc type gasket is used between the brackets and cylinder head to prevent oil leakage. Before installing new gaskets, remove any part of the old gaskets that may be adhering to the bracket or head to assure solid seating.

Tighten the bolts equally and finally torque to 40 lbs. ft. maximum. See Figure 2-53.

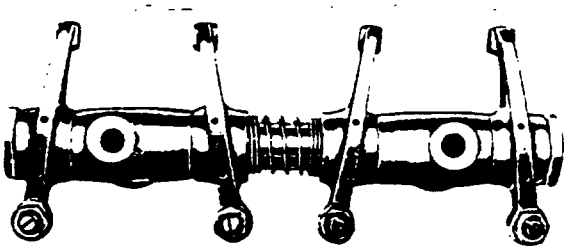


Figure 2-53. Rocker Arm and Shaft Assy.

When the rocker arm and shaft assembly is installed on the engine, carefully check outer rocker arms for possible binding between bracket and hex head plug. Rap opposite end of shaft with hammer to free.

Naturally Aspirated Diesel (END475)

Adjust valve clearance (cold engine setting); inlet valve, 0.014 in. and exhaust valve, 0.018 in.

Turbocharged Diesel (ENDT475)

Inlet valve, 0.014 in. and exhaust valve 0.028 in. Squirt engine oil over valve mechanism and at valve stems for initial protection.

NOTE

As soon as engine is running, observe to be sure lubricating oil is flowing from all rocker arms.

CYLINDER BLOCK

Description

The cylinder and upper crankcase is an integral casting of alloy cast iron. See Figure 2-54. It features replaceable wet-type cylinder sleeves flanged at the top to fit in the counterbores on the cylinder block deck. Three O-ring type seals are employed to seal the lower areas of the sleeve at the water jacket. The O-rings are resistant to oil and heat.

The standard cylinder sleeve I.D. is 4.527. This is the only size available. A worn or scored sleeve must be replaced with a new sleeve because the piston and piston rings are also only available in standard size. Cylinder sleeves may be removed by using puller J-21376 and sleeve puller shoe J-21587. See Figure 2-55.

Cylinder Head Installation

Each cylinder head is secured to the cylinder block by twenty 5/8 in. diameter studs, flat washers and nuts. Use new studs and manifold capscrews at overhaul.

Oil the coarse stud threads lightly with SAE 30 engine oil. Insert studs finger-tight into block until bottomed, then back them off 1/3 turn. Wipe deck surface to remove oil, etc. Place cylinder head gaskets in their proper positions on the block checking that the rubber seals are correctly positioned in holes of gasket.

NOTE

Do not water soak or use sealing compounds or other coatings on gasket, block or head surfaces.

Set cleaned cylinder heads in place separately. When in place, apply Permatex No. 2 to the accessible outer edges of gasket. Lightly oil all cylinder head stud nut bosses, stud and nut threads and washers with engine oil. Install washers and nuts finger-tight. Assemble manifolds using new gaskets, but do not tighten nuts and capscrews until cylinder heads are torqued down. Tighten all cylinder head stud nuts, one head at a time, using the following procedure. See Figure 2-117.

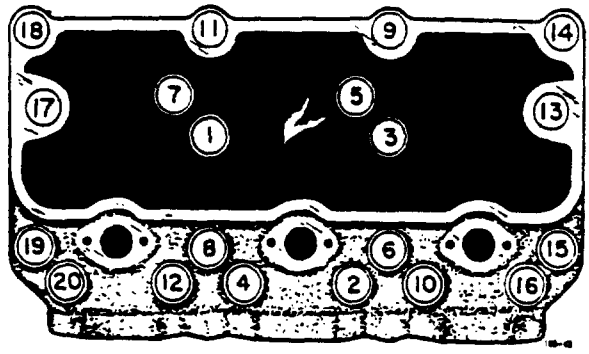


Figure 2-117. Cylinder Head Stud Nut Tightening Sequence

Tighten all stud nuts to 50 lb. ft. torque, following sequence in Figure 5. Tighten again in sequence, to 100 lb. ft. torque. Tighten finally, in sequence, to 175 lb. ft. When all stud nuts have been tightened to their specified torque, the top of the stud should be flush to three threads above the top of the nut. After engine run in, cylinder head stud nuts must be retorqued. Refer to Mack Piston Ring Set package for detailed instructions.

CYLINDER BLOCK

Chrome-nickel alloy. An integral water manifold distributes cool water around the upper area of the water jacket. The cylinders are bored to take dry type cylinder liners. The deck area surface must be flat within 0.002 in. Excessively eroded water holes developing at deck area must be repaired. Drill, tap and install bronze plug. Mark center using cylinder head gasket as a template and drill new water hole. Finish plug off flat with deck surface. Do not mill deck surface if piston head will protrude more than 0.020 in. above cylinder deck surface. Remove all core hole plugs to remove rust scale and silt deposits from water compartments. Use new O-rings and coat with sealing compound National Machine Products Oil and Water Sealer, or equivalent, when reinstalling plugs.

Cylinder Liner

Dry type special alloy iron. Part number is etched on O.D. of liner. Free O.D is 5.0945 to 5.0955 in. Cylinder block bore is 5.0945 to 5.0955 in. which allows a liner fit of 0.0010 loose to 0.0010 in. tight. Cylinder liner I.D. for standard size piston, 4.876 to 4.877 in. Cylinder liners available in 0.002, 0.004, 0.006, 0.012, 0.020, 0.030, 0.040, and 0.050 in. O.D. oversize. Extension of cylinder liners above cylinder block deck must not vary more than 0.001 in. under the same head.

When replacing cylinder liners, check cylinder block bore. If out-of-round or taper does not exceed 0.006 in., hone block for 0.002, 0.004, or 0.006 in. oversize liner as required. If out-of-round or taper exceeds 0.006 in., bore cylinder block for 0.012 in. or larger oversize liner as required.

Main bearing caps must be in place and capscrews must be torqued when cylinder block is honed or bored.

Maximum permissible out-of-round or taper of cylinder liner bore is 0.002 in. Remove honing grit by swabbing bore with a cloth saturated with clean SAE 10 oil. Remove all traces of oil with solvent and blow dry with clean, dry compressed air. If liner enters 1/2 to 2/3 of the bore, a light press on top of liner should suffice. Stop pressing when liner is 1/2 in. from deck, clean counterbore with compressed air and then seat liner in

Exhaust Valve

Poppet type. Valve face angle, 30 degrees +0'/30'. Reamed I.D. of exhaust valve guide, 0.4995 to 0.5005 in. Valve stem diameter, 0.4955 to 0.4965 in. Stem-to-guide clearance (service), 0.003 to 0.005 in. Maximum face runout (service), 0.0015 in. Stem-to-rocker arm lash setting, 0.024 in. cold static, 0.022 in. hot idle. Use new valve rotators and keys at overhaul.

Inner Valve Spring

Nominal free length, 3-1/32 in. Test for 82.1 to 90.7 lbs. when compressed to 2-1/32 in. Service limit, 77.2 lbs.

Outer Valve Spring

Nominal free length, 3-13/32 in. Test for 105.3 to 116.3 lbs. when compressed to 2-5/32 in. Service limit, 99 lbs.

Rocker Arm Shaft

Shaft O.D., 1.1286 to 1.1291 in. Drilled for bottom oil feed of rocker arms. Locating screw assures proper line-up of oil passage.

Rocker Arm

Ratio 1.8 to 1. Shaft hole diameters, 1.1296 to 1.1301 in. Hole-to-shaft clearance is 0.0005 to 0.0015 in.

Before installing rocker arm and shaft assembly on cylinder head, be sure to fit O-ring carefully in recess at oil passage-to-rocker arm bracket on top of cylinder head.

Rocker arm bracket capscrew torque, 35 lb. ft.

Cylinder Head Installation

Each cylinder head is secured to the cylinder block by twenty 5/8 in. diameter studs, flat washers and nuts. Use new studs and manifold capscrews at overhaul.

Oil of coarse stud threads lightly with SAE 30 engine oil. Insert studs finger-tight into block until bottomed, then back them off 1/3 turn. Wipe deck surface to remove oil, etc. Place cylinder head gaskets in their proper positions on the block checking that the rubber seals are correctly positioned in holes of gasket.

NOTE

Do not water soak or use sealing compounds or other coatings on gasket, block or head surfaces.

Check cylinder head deck surface and fire ring groove to be sure they are clean and free of carbon. Set cleaned cylinder heads in place separately. Lightly oil all cylinder head stud nut bosses, stud and nut threads and washers with engine oil. Install washers and nuts finger-tight. Assemble manifolds using new gaskets, but do not tighten nuts and capscrews until cylinder heads are torqued down. Tighten all cylinder head stud nuts, one head at a time, using the following procedure. See Figure 2-134.

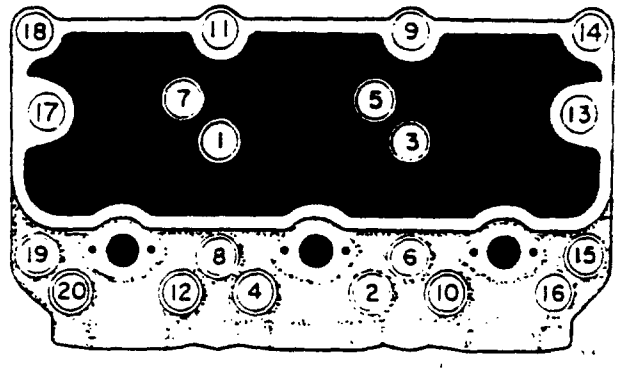


Figure 2-134. Cylinder Head Stud Nut Tightening Sequence

Tighten all stud nuts to 50 lb. ft. torque, following sequence in Figure 2-134. Tighten again in sequence, to 100 lb. ft. torque. Tighten finally, in sequence, to 175 lb. ft. When all stud nuts have been tightened to their specified torque, the top of the stud should be flush to three threads above the top of the nut. After engine run in, cylinder head stud nuts must be retorqued. Refer to Mack Piston Ring set package for run-in procedure.

CYLINDER BLOCK

Chrome-nickel alloy. An integral water manifold distributes cool water around the upper area of the water jacket. The cylinders are bored to take dry type cylinder liners. The deck area surface must be flat within 0.002 in. Excessively eroded water holes developing at deck area must be repaired. Drill, tap and install bronze plug. Mark center using cylinder head gasket as a template and drill new water hole. Finish

Cylinder Head Installation

Each cylinder head is secured to the cylinder block by twenty 5/8 in. diameter studs, flat washers and nuts. Use new studs and manifold capscrews at overhaul.

Oil the coarse stud threads lightly with SAE 30 engine oil. Insert studs finger-tight into block until bottomed, then back them off 1/3 turn. Wipe deck surface to remove oil, etc. Place cylinder head gaskets and fire rings in their proper positions on the block.

New cylinder head gaskets and fire rings must be installed each time the cylinder heads are removed. Clean sealing grooves in head surface and liner flanges using a brass wire rotary brush - absolute cleanliness is essential.

Set cleaned cylinder heads in place separately. Lightly oil all cylinder head stud nut bosses, stud and nut threads and washers with engine oil. Install washers and nuts finger-tight. Assemble manifolds using new gaskets, but do not tighten nuts and capscrews until cylinder heads are torqued down. Tighten all cylinder head stud nuts, one head at a time, using the following procedure.

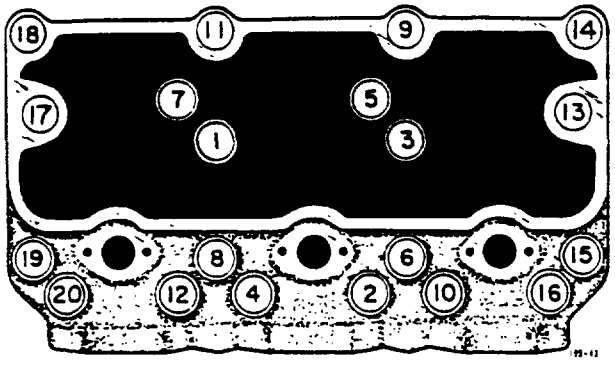


Figure 2-154. Cylinder Head Stud Nut Tightening Sequence

Tighten all stud nuts to 50 lb. ft. torque, following sequence in Figure 2-154. Tighten again in sequence, to 100 lb. ft. torque. Tighten finally, in sequence, to 175 lb. ft. When all stud nuts have been tightened to their specified torque, the top of stud should be flush to three threads above top of the nut. After engine run-in, cylinder head stud nuts must be retorqued. Refer to Mack Piston Ring set package for run-in procedure.

CYLINDER BLOCK

Chrome-nickel alloy. An integral water manifold distributes cool water around the upper area of the water jacket. The cylinders are bored to take dry cylinder liners. The deck area surface must be flat within 0.002 in. Excessively eroded water holes developing at the deck area must be repaired. Drill, tap and install bronze plug. Mark center using cylinder head gasket as a template and drill new water hole. Finish plug off flat with deck surface. Do not mill deck surface if piston head will protrude more than 0.020 in. above cylinder deck surface. Remove all core hole plugs to remove rust scale and silt deposits from water compartments. Use new O-rings and coat with sealing compound National Machine Products Oil and Water Sealer, or equivalent, when reinstalling plugs.

Cylinder Liner

Dry type special alloy iron. Part number is etched on O.D. of liner. Free O.D. is 5.0945 to 5.0955 in. Cylinder block bore is 5.0945 to 5.0955 in. which allows a liner fit of 0.001 loose to 0.001 in. tight. Cylinder liner I.D. for standard size piston, 4.876 to 4.877 in. Cylinder liners are available in 0.002, 0.004, 0.006, 0.012 and 0.020 inch O.D. oversize. This liner is provided with a 3/64 x 0.008 in. high bead at the top outer edge of the flange. When installing liner, the flange must extend 0.0035 to 0.0075 inch above the deck surface. This is taken from the channel depth, not from top of bead, see Figure 2-155. The head embeds into the fire ring, which is a separate part of the cylinder head gasket. Extension of cylinder liners above cylinder block deck must not vary more than 0.001 in. under the same head.

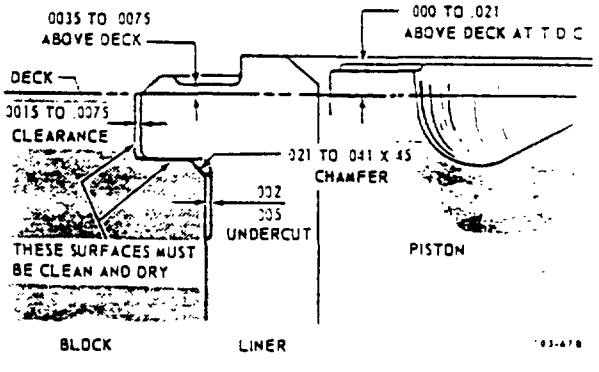


Figure 2-155. Cylinder Liner Detail

When replacing cylinder liners, check cylinder block bore. If out-of-round or taper does not exceed 0.006 in., hone block for 0.002, 0.004, or 0.006 in. oversize liner as required. If out-of-round or taper exceeds 0.006 in., bore cylinder block for 0.012 in. or larger oversize liner as required.

washers and nuts. Use new studs and manifold capscrews at overhaul.

Oil the coarse stud threads lightly with SAE 30 engine oil. Insert the studs finger-tight into block until bottomed, then back them off 1/3 turn. Clean sealing grooves in head surface and liner flanges using a brass wire rotary brush. Absolute cleanliness is essential. Wipe deck surface to remove oil, etc. Place cylinder head gaskets and fire rings in their proper positions on the block.

NOTE

New cylinder head gaskets and fire rings must be installed each time the cylinder heads are removed. Do not water soak or use sealing compounds or other coatings on gasket, block or head surfaces.

Check cylinder head deck surface and fire ring groove to be sure they are clean and free of carbon. Set cleaned cylinder heads in place separately. Lightly oil all cylinder head stud nut bosses, stud and nut threads and washers with engine oil. Install washers and nuts finger-tight. Assemble manifolds using new gaskets, but do not tighten nuts and capscrews until cylinder heads are torqued down. Tighten all cylinder head stud nuts, one head at a time, using the following procedure. Tighten all stud nuts to 50 lb. ft. torque following sequence in Figure 2-173. Tighten again, in sequence, to 100 lb. ft. torque. Tighten finally, in sequence to 175 lb. ft. When all stud nuts have been tightened to their specified torque, the top of the stud should be flush to three threads above the top of the nut. After engine run in, cylinder head stud nuts must be retorqued. Refer to Mack Piston Ring set package for run in procedure, and do not deviate from it.

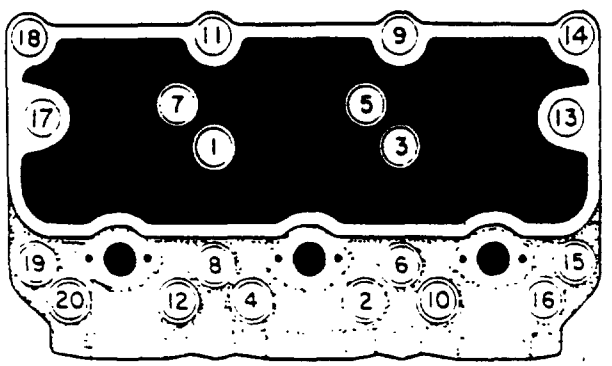


Figure 2-173. Cylinder Head Stud Nut Tightening Sequence

CYLINDER BLOCK

The cylinder block is an alloy casting with an integral cast water manifold to distribute coolant around the upper area of the block. Drilled passages are incorporated for transfer of coolant to the cylinder head and the proper distribution of lubricating oil to the various parts of the engine. The cylinders are bored to take dry cylinder liners. The deck area surface must be flat within 0.0020 inch under area covered by individual head. Excessively eroded water holes at deck area must be repaired. To repair these holes, drill, tap and install bronze plug. Complete repair by drilling a new water hole using cylinder head gasket at template. Finish plug off flat with deck surface. Do not mill deck surface if piston head will protrude more than 0.021 inch above cylinder deck surface. Remove all core hole plugs to remove rust scale and silt deposits from water compartments. Use new O-rings and coat with sealing compound National Machine Products Oil and Water Sealer, or equivalent, when reinstalling plugs.

A machined oil pad is provided on the left hand side of the cylinder block. Porting in the pad corresponds to the porting in the oil pressure relief valve assembly.

Cylinder Liner

The cylinder liners are a special alloy cast iron with part number etched on O.D. Free O.D. is 5.0945 to 5.0955 inch. Cylinder block bore is 5.0945 to 5.0955 inch which allows a liner fit of 0.0010 inch loose to 0.0010 inch tight. Cylinder liner I.D. for standard size piston; 4.875 to 4.877 inch. Cylinder liners available in 0.002, 0.004, 0.006, 0.012, 0.020, 0.030, 0.040 and 0.050 inch O.D. oversize. This liner is provided with a 3/64 inch wide x 0.008 inch high bead, at the top outer edge of the flange. When installing liner, the flange must extend 0.0035 to 0.0075 inch above the deck surface. This is taken from the channel depth, not from top of bead. See Figure 2-174. The bead embeds into the fire ring, which is a separate part of the cylinder head gasket.

Extension of cylinder liners above cylinder block deck must not vary more than 0.001 inch under the same head.

Maximum permissible out-of-round or taper of cylinder liner bore is 0.003 inch.

Cylinder Head Installation

Each cylinder head is secured to the cylinder block by twenty 5/8 in. diameter studs, flat washers and nuts. Use new studs and manifold capscrews at overhaul.

Oil the coarse stud threads lightly with SAE 30 engine oil. Insert studs finger-tight into block until bottomed, then back them off 1/3 turn. Wipe deck surface to remove oil, etc. Place cylinder head gaskets in their proper positions on the block checking that the rubber seals are correctly positioned in holes of gasket.

NOTE

Do not water soak or use sealing compounds or other coatings on gasket, block or head surfaces.

Set cleaned cylinder heads in place separately. When in place, apply Permatex No. 2 to the accessible outer edges of gasket. Lightly oil all cylinder head stud nut bosses, stud and nut threads and washers with engine oil. Install washers and nuts finger-tight. Assemble manifolds using new gaskets, but do not tighten nuts and capscrews until cylinder heads are torqued down. Tighten all cylinder head stud nuts, one head at a time, using the following procedure. See Figure 2-194.

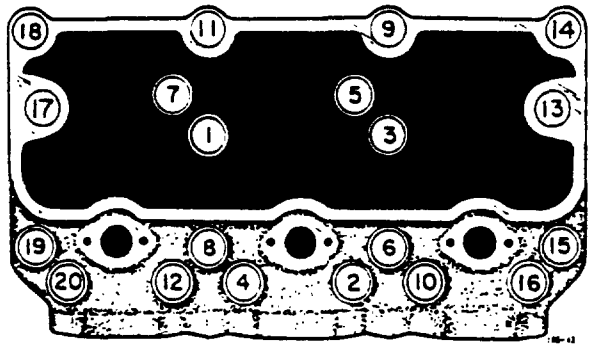


Figure 2-194. Cylinder Head Stud Nut Tightening Sequence

Tighten all stud nuts to 50 lb. ft. torque, following sequence in Figure 5. Tighten again in sequence, to 100 lb. ft. torque. Tighten finally, in sequence, to 175 lb. ft. When all stud nuts have been tightened to their specified torque, the top of stud should be flush to three threads above top of the nut. After engine run in, cylinder head stud nuts must be retorqued. Refer to Mack Piston Ring set package for run-in procedure.

Chrome-nickel alloy. An integral water manifold distributes cool water around the upper area of the water jacket. The cylinders are bored to take dry cylinder liners. The deck area surface must be flat within 0.002 in. Excessively eroded water holes developing at the deck area must be repaired. Drill, tap and install bronze plug. Mark center using cylinder head gasket as a template and drill new water hole. Finish plug off flat with deck surface. Do not mill deck surface if piston head will protrude more than 0.020 in. above cylinder deck surface. Remove all core hole plugs to remove rust scale and silt deposits from water compartments. Use new O-rings and coat with sealing compound National Machine Products Oil and Water Sealer, or equivalent, when reinstalling plugs.

Two oil galleries are provided, the main oil gallery and another directly below which supplies oil for piston cooling. Tapped passages from lower oil gallery index with jet spray nozzles which spray cooling oil on the underside of the pistons.

Cylinder Liner

Dry type special alloy iron. Part number is etched on O.D. of liner. Free O.D. is 5.0945 to 5.0955 in. Cylinder block bore is 5.0945 to 5.0955 in. which allows a liner fit of 0.001 loose to 0.001 in. tight. Cylinder liner I.D. for standard size piston, 4.876 to 4.877 in. Cylinder liners available in 0.002, 0.004, 0.006, 0.012, 0.020, 0.030, 0.040 and 0.050 in. O.D. oversize. Extension of cylinder liners above cylinder block deck must not vary more than 0.001 in. under the same head. See Figure 2-195.

When replacing cylinder liners, check cylinder block bore. If out-of-round or taper does not exceed 0.006 in., hone block for 0.002, 0.004, or 0.006 in. oversize liner as required. If out-of-round or taper exceeds 0.006 in., bore cylinder block for 0.012 in. or larger oversize liner as required.

Main bearing caps must be in place and capscrews must be torqued when cylinder block is honed or bored.

Maximum permissible out-of-round or taper of cylinder liner bore is 0.003 in.

Cylinder Head Installation

Each cylinder head is secured to the cylinder block by twenty 5/8 inch diameter studs, flat washers and nuts. Use new studs and manifold capscrews at overhaul.

Oil the coarse stud threads lightly with SAE 30 engine oil. Insert the studs finger-tight into block until bottomed, then back them off 1/3 turn. Clean sealing grooves in head surface and liner flanges using a brass wire rotary brush. Absolute cleanliness is essential. Wipe deck surface to remove oil, etc. Place cylinder head gaskets and fire rings in their proper positions on the block.

NOTE

New cylinder head gaskets and fire rings must be installed each time the cylinder heads are removed. Do not water soak or use sealing compounds or other coatings on gasket, block or head surfaces.

Check cylinder head deck surface and fire ring groove to be sure they are clean and free of carbon. Set cleaned cylinder heads in place separately. Lightly oil all cylinder head stud nut bosses, stud and nut threads and washers with engine oil. Install washers and nuts finger-tight. Assemble manifolds using new gaskets, but do not tighten nuts and capscrews until cylinder heads are torqued down. Tighten all cylinder head stud nuts, one head at a time, using the following procedure. Tighten all stud nuts to 50 lb. ft. torque following sequences in Figure 2-216. Tighten again, in sequence, to 100 lb. ft. torque. Tighten finally, in sequence, to 175 lb. ft. When all stud nuts have been tightened to their specified torque, the top of the stud should be flush to three threads above the top of the nut. After engine run in, cylinder head stud nuts must be retorqued. Refer to Mack Piston Ring set package for run in procedure, and do not deviate from it.

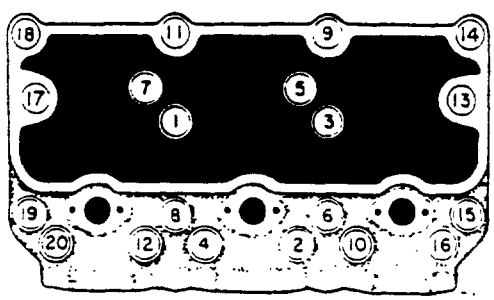


Figure 2-216. Cylinder Head Stud Nut Tightening Sequence

CYLINDER BLOCK

The cylinder block is an alloy casting with an integral cast water manifold to distribute coolant around the upper area of the block. Drilled passages are incorporated for transfer of coolant to the cylinder head and the proper distribution of lubricating oil to the various parts of the engine. The cylinders are bored to take dry cylinder liners. The deck area surface must be flat within 0.0020 inch under area covered by individual head. Excessively eroded water holes at deck area must be repaired. To repair these holes, drill, tap, and install bronze plug. Complete repair by drilling a new water hole using cylinder head gasket as template. Finish plug off flat with deck surface. Do not mill deck surface if piston head will protrude more than 0.020 inch above cylinder deck surface. Remove all core hole plugs to remove rust scale and silt deposits from water compartments. Use new O-rings and coat with sealing compound National Machine Produces Oil and Water Sealer or equivalent, when reinstalling plugs.

Two oil galleries are provided: the main oil gallery and another directly below which supplies oil for piston cooling. Tapped passages from the lower oil gallery index with jet spray nozzles which spray cooling oil on the underside of the pistons.

Cylinder Liner

The cylinder liners are a special alloy cast iron with part number etched on O.D. Free O.D. is 5.0945 to 5.0955 inch. Cylinder block bore is 5.0945 to 5.0955 inch which allows a liner fit of 0.0010 inch loose to 0.0010 inch tight. Cylinder liner I.D. for standard size piston, 4.875 to 4.877 inch. Cylinder liners available in 0.002, 0.004, 0.006, 0.012, 0.020, 0.030, 0.040 and 0.050 inch O.D. oversize. This liner is provided with a 3/64 inch wide x 0.008 inch high bead, at the top outer edge of the flange. When installing liner, the flange must extend 0.0035 to 0.0075 inch above the deck surface. This is taken from the channel depth, not from top of bead. See Figure 2-217. The bead embeds into the fire ring, which is a separate part of the cylinder head gasket.

Extension of cylinder liners above cylinder block deck must not vary more than 0.001 inch under the same head.

Maximum permissible out-of-round or taper of cylinder liner bore is 0.003 inch.

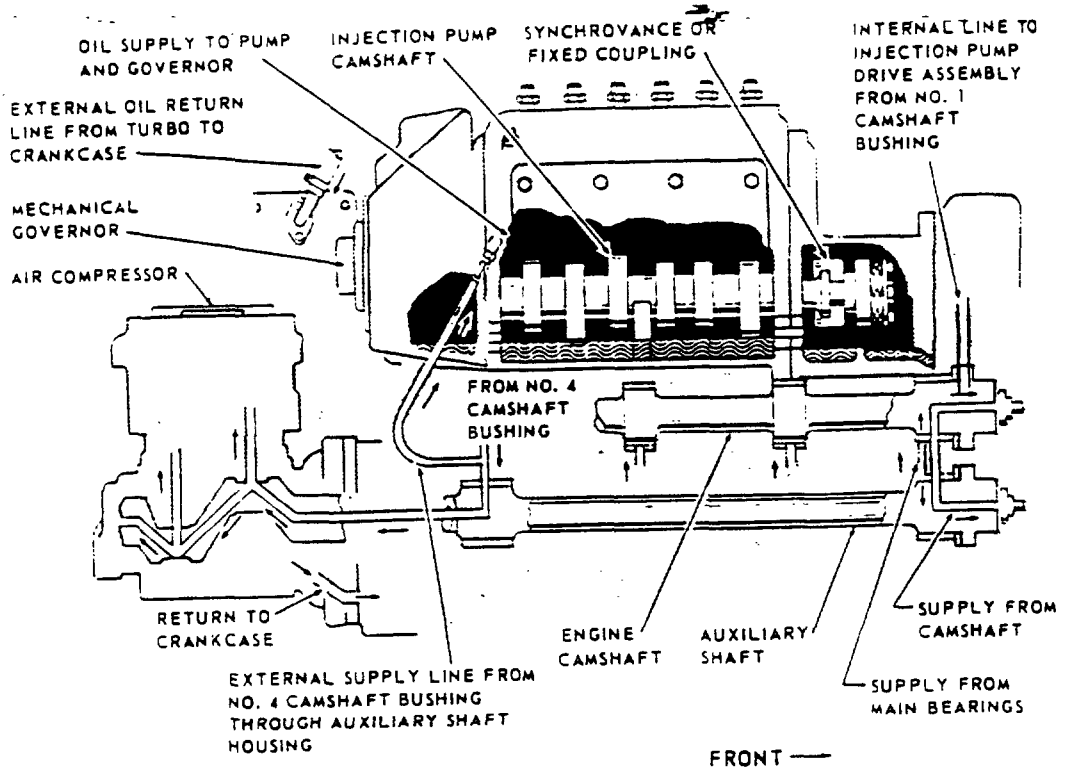


Figure 2-301. Auxiliary Drive and Injection Pump Lubrication

OIL PAN

Inspection

Inspect oil pan for dents, cracks and condition of flange, bolt holes for elongation and baffle for security. Inspect drain hole for condition of threads.

Installation

Position gasket on oil pan and position oil pan on cylinder block. Install and tighten oil pan retaining capscrews evenly to prevent oil leakage.

CYLINDER HEAD STUDS

Inspection

Check cylinder head studs for condition of threads, and straightness of shank.

Installation

Apply a light coat of lubricating oil to threads of studs and install them in cylinder block finger-tight, then back off 1/3 turn.

CYLINDER HEAD INSTALLATION

CAUTION

New cylinder head gaskets and fire rings must be installed each time cylinder heads are removed.

Place cylinder head gasket over studs on cylinder block. Be sure that all passages are open and not blocked by gasket. Make sure fire rings are properly positioned. Cylinder gaskets are precoated; no soaking, coating or sealants are required. Use gaskets as received.

Position cylinder head over studs and gently onto cylinder block. See Figure 2-302. Be sure no foreign material is in cylinder.

Install cylinder head stud washers and nuts. Torque cylinder stud nuts in progressive steps of 50 lb. ft. using proper tightening sequence. See Figure 2-303.

Installation

1. Install rocker arm assembly to cylinder head. Be sure rocker arm bracket with oil hole is over O-ring seal.

2. Install rocker arm bracket capscrews and tighten to proper torque.

VALVE LASH ADJUSTMENT

The valve lash on standard non-brake engines can be adjusted cold static or hot idle; however, the valve lash on engines fitted with the Dynatard engine brake system can only be adjusted cold static.

To Adjust Valve Lash Cold Static

(Water Temperature Below 100 Degrees F.)

The valve lash for inlet and exhaust valves are adjusted in firing order with corresponding cylinder piston at TDC. Firing order for these engines is 1-5-3-6-2-4.

1. Set No. 1 cylinder piston TDC by use of timing marks on the vibration damper or flywheel.

2. Adjust inlet valve lash (cold static) 0.016 inch and exhaust 0.024 inch.

NOTE

Engines with Dynatard brake system use special exhaust valve adjusting tool MVT-36-6 and press downward with hand on exhaust adjusting screw while gaging valve lash.

3. Following No. 1 cylinder adjustment, turn crankshaft 1.3 turn clockwise in direction and place No. 5 cylinder at TDC. Adjust valves as outlined in step 2.

4. Continue adjusting valve lash for the remaining cylinder pistons in firing order placing each cylinder piston at TDC with respective 1/3 turns of the engine crankshaft.

5. Properly secure adjusting screw locknut after each cylinder piston valve lash adjustment.

To Adjust Valve Lash Hot Idle

(Not Recommended for Engines with the Dynatard Engine Brake System)

1. Start engine and warm up to normal operating temperature.

2. Set valve lash at hot idle (600 to 650 rpm) inlet valve 0.014 inch, exhaust 0.022 inch.

3. Properly secure adjusting screw locknut after each cylinder piston valve lash adjustment.

WATER OUTLET MANIFOLD

Inspection

Inspect water outlet manifold for restrictions. Check mounting flanges for cracks and straightness.

Installation

Place new hose and clamps between front half and rear half of the water outlet manifold. Place new gaskets between water manifold and cylinder head. Install and tighten attaching capscrews to the proper torque. Position hoses and hose clamps as applicable.

Install thermostat and by-pass fitting and thermostat housing cover and seal as applicable. See Figure 2-307.

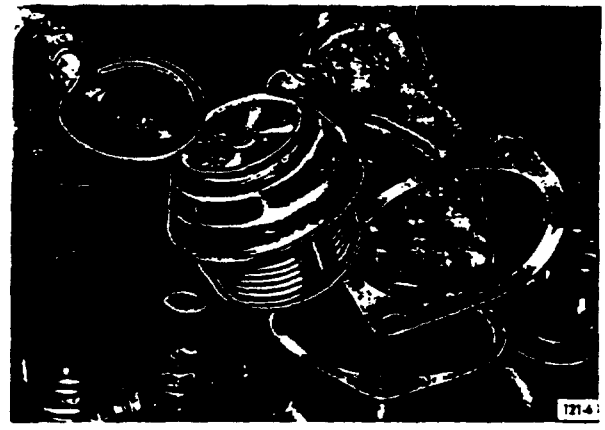


Figure 2-307. Installing Thermostat (Non-ESI)

NOTE

Thermostat on ESI engines located in front water manifold behind water conditioner and water fitting.

WATER PUMP

Description

The water pump is a centrifugal-rotor type, V-belt driven from the crankshaft. The pump cover contains the grease cavity and provisions for two, single row, ball bearings which support the shaft. The bearings

Installation - See Figure 2-310.

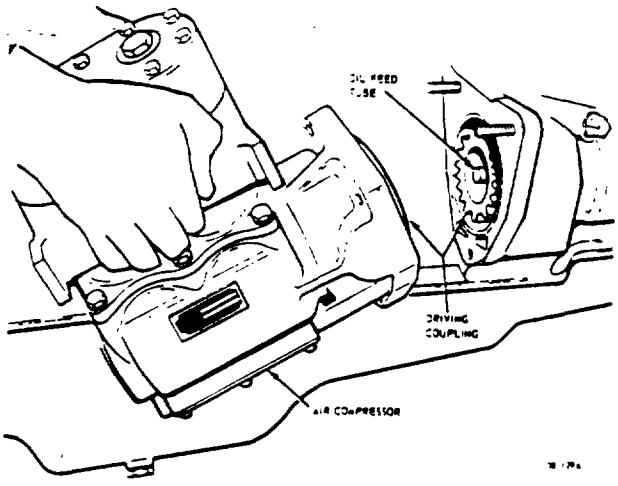


Figure 2-310. Installing Air Compressor

The air compressor is "phased" or "timed" to the engine. A tooth in the bore of the fiber coupling is shaved down to clear a pin in the drive coupling. The compressor can be installed only one way. If difficulty is experienced, recheck to insure coupling and drive are in proper mesh.

Current production engines do not require phasing or timing. The pin has been omitted from the drive coupling.

Be sure oil transfer tube is tight in end of auxiliary driveshaft.

Position air compressor adapter ring, if used, into auxiliary housing counterbore. Place gasket on air compressor and position on auxiliary housing. Install and torque air compressor retaining capscrews or nuts.

WARNING

Recheck auxiliary shaft end float after installing air compressor or vacuum pump.

FUEL INJECTION LINES, HIGH PRESSURE

Description

Fuel injection lines are seamless cold-drawn high tensile steel. All lines on one engine are of identical length and inside diameter.

Inspection

Inspect fuel injection line for chafing, dents, nicks or sharp bends. Check fittings, seat and threads for condition. Check lines to be sure they are not restricted.

Installation

Install fuel injection nozzles. Install fuel injection lines and be sure brackets are properly positioned to prevent lines from chafing.

The lines should fit without difficulty if they have not been changed around. NEVER BEND THE LINES TO MAKE THEM FIT.

Torque fuel injection lines at injection nozzles and pump locations. Torque injection line brackets.

INLET MANIFOLD

Inspection

Inspect inlet manifold for restrictions. Check mounting flanges for erosion, cracks and straightness.

Installation

Place new gaskets between inlet manifold and cylinder head. Install and tighten attaching capscrews to the proper torque.

EXHAUST MANIFOLD

Inspection

Inspect the exhaust manifold for restrictions. Check mounting flanges for erosion, cracks and straightness.

Installation

Place new gaskets between exhaust manifold and cylinder head. Install and tighten the attaching washers and nuts to the proper torque.

ROCKER ARM COVERS

Inspection

Inspect rocker arm covers for cleanliness, dents and straightness of flange. Check breather in cover, if applicable, to be sure it is not plugged.

Installation

Cement new gasket to mounting flange of rocker arm cover.

Position cover over rocker arms; install and torque cover retaining capscrews or nuts as applicable.

TURBOCHARGER

Description

The turbocharger is an exhaust gas driven air compressor. See Figure 2-311. The purpose of the turbocharger is to increase the supply of air to the cylinders and thus burn more fuel which in turn produces more power.

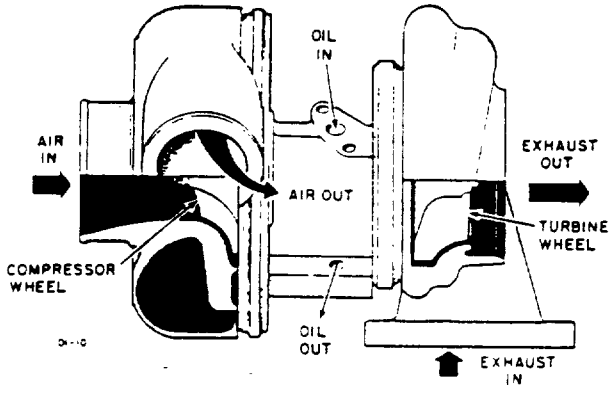


Figure 2-311. Exhaust Driven Turbocharger

The turbocharger consists of three main parts; the turbine housing, the bearing housing and the compressor housing. The turbine housing is located at one end of the bearing housing and the compressor housing is located at the other end. A common shaft connects the turbine wheel and compressor wheel.

The turbine end of the turbocharger uses exhaust gas energy normally discharged to the atmosphere. The exhaust gas enters the turbocharger through the flange connection on the exhaust manifold. The exhaust gas flows around the turbine housing and radially inward causing the turbine wheel to rotate. The exhaust gas is then discharged through the center of the turbine housing into the exhaust pipe.

The bearing housing contains the through-shaft, bearings, seals, and oil passages.

The bearings are of the floating sleeve type and are pressure lubricated from the engine oil supply system. Piston ring type oil seals are used at each end of the shaft to effectively seal off the oil.

The compressor housing contains the compressor wheel and air enters at the center of the compressor wheel and flows radially outward into the compressor housing. The air leaves through a tangential outlet on the outside of the compressor housing and is ducted to the inlet manifold.

Checks Before Removal

If turbocharger malfunction is suspected, make the following checks before removal of turbocharger from the engine.

1. Start engine and check for unusual noise or vibration from turbocharger. This will indicate out-of-balance, rubbing or damage to compressor or turbine wheels.

2. Check for leaks in the air system from turbocharger to intake manifold and from intake manifold to cylinder block. Be sure all bolts, clamps and connections are tight and gaskets are not blown and are in proper location.

3. Check air cleaner and air intake system, from the air cleaner to turbocharger, for restrictions to air flow or leaks.

4. Check exhaust system, from cylinder block to turbocharger, for exhaust leaks. Be sure all bolts, clamps and connections are tight and gaskets are not blown and are in proper location.

5. Check exhaust system from turbocharger to outlet for restrictions.

6. Check turbine wheel for radial and axial looseness. If radial and/or axial looseness is excessive, the turbocharger will have to be removed for overhaul. If turbocharger has to be overhauled, consult your Mack Branch or Distributor for details on turbocharger exchange program.

Cleaning

The compressor end of the turbocharger should be cleaned after 1000 to 2000 hours of operation. If the compressor wheel is not too dirty, it can be cleaned with the turbocharger on the engine.

Disconnect compressor discharge flange; remove the capscrews or clamp ring that holds the compressor housing to the bearing housing, and pull compressor housing carefully along turbocharger axis to prevent damage to the compressor wheel or the diffuser.

Use Bendix Metal Cleaner or equivalent solvent to clean compressor wheel. Do not use a caustic solution or any other type that may attack aluminum, as this will either weaken the impeller or destroy its balance. Do not use a wire brush or scraper; a brush with nylon or hog bristles is preferred.

If compressor wheel is found to be very dirty, remove turbocharger from the engine for cleaning. With compressor housing removed, immerse compressor wheel into the cleaning fluid and allow to soak. Use care not to rest weight of turbocharger on compressor wheel or on end of shaft.

The turbine end of turbocharger can be cleaned only after removal from the engine and separation of the bearing housing from the turbine housing.

Installation Guide

Use the following steps as a guide when installing turbocharger to engine.

1. Inspect air intake system for cleanliness, leakage and foreign material.

2. Inspect exhaust manifold for foreign material.

3. Inspect oil drain line to be sure it is not clogged or restricted.

4. Inspect oil supply line for restriction, deterioration or possibility of leaking under pressure. Be sure check valve is working properly and not restricted.

5. Inspect turbocharger mounting pad, on exhaust manifold, for erosion, flatness and to be sure old gasket is removed.

6. Place new gasket on exhaust manifold, position turbocharger and install attaching bolts.

7. Connect oil inlet line and oil drain line to turbocharger.

8. Connect compressor inlet and outlet piping. Check to be sure all clamps and bolts are tight. Be sure piping is not producing strain on compressor cover.

9. Crank engine, without firing, until a steady flow of oil is noted coming from the oil drain outlet of the turbocharger.

10. Stop cranking engine and connect oil drain line to engine. Be sure drain line slopes downward throughout its length with no sharp bends or kinks.

ENGINE BREAK-IN PROCEDURE AFTER OVERHAUL OR REBUILD

Comparative tests and careful review of engine break-in methods have proven that a short run under full load is substantially more effective than the light or no load slow speed increase type of break-in. Compatibility between the critical components (piston, rings and bores) is greatly improved by raising engine speed and applying full load immediately after warm-up.

Use the recommended type and grade engine oil and fuel as required for usual operation of the vehicle.

Immediately prior to initial starting of the engine, the fuel system, oil galleries and filters are to be primed preferably by means of a pressure tank.

Check the air intake system to be sure all joints are tight and the filter element and system are clean.

After break-in procedure is complete, recheck cylinder head stud nut torque and valve clearance adjustment.

NOTE

Torque cylinder head studs. Back off each nut individually in proper sequence. See Figure 3-303. Oil threads and washer and tighten to the recommended torque.

When the vehicle is put into service, treat the engine as though it were new and follow the "Breaking in a New Vehicle" instructions listed in the Operation Manual.

Position inner and outer valve springs over the exhaust and intake valves. Position the rotator washers over the valve stems and install keys using a suitable tool to compress valve springs.

CYLINDER BLOCK

Description

The cylinder block is an alloy casting with an integral cast water manifold to distribute coolant around the upper area of the block. Drilled passages are incorporated for transfer of coolant to the cylinder head and the proper distribution of lubrication oil to the various parts of the engine.

Check cylinder block deck surface for warpage. If warpage is excessive, be sure that the maximum amount of material removal limit is not exceeded.

CAUTION

The piston travel above the cylinder block deck is critical and must be checked during assembly to insure proper clearance of piston with cylinder head and valves.

Remove all core plugs and fittings from cylinder block and remove any accumulation of rust and sludge. Check block for cracks, condition of threaded holes and straightness of mating flanges.

Coat new O-rings with sealant, place on core plugs and install plugs in block. Install all oil gallery plugs and gaskets using Permatex sealant or equivalent, to insure positive sealing.

Cylinder Liners, Dry Type

Cylinder liners are of a special alloy and are available in O.D. oversizes I.D. of all liners are standard size.

NOTE

Use bolts and washers to retain cylinder liners as soon as heads are removed. See Figure 2-321.

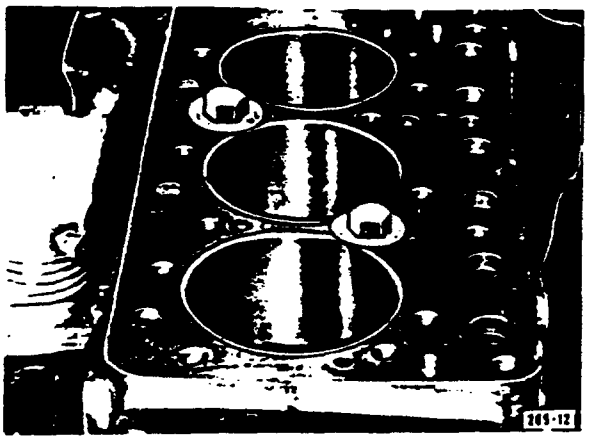


Figure 2-321. Method of Retaining Cylinder Liner

Clean liner flanges using a brass wire rotary brush to be sure of effective fire ring sealing. Check cylinder liner for out-of-round and taper. Use tool J5347-01, see Figure 2-322 and measure each liner I.D. Take readings in two directions at each of at least three levels. See Figure 2-323. Check cylinder liner height above cylinder block. Use gage, Sweeney 6020. See Figures 2-324 and 2-325.

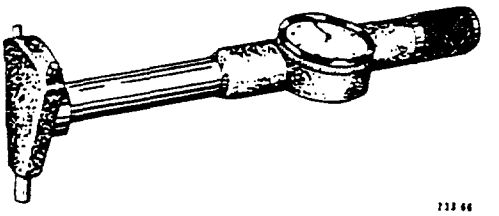


Figure 2-322. Cylinder Liner Bore Measuring Tool

Inspection

1. Inspect the auxiliary shaft journals for wear and galling.

2. Inspect gear for wear pattern, cracked, chipped or broken teeth.

3. Inspect keyway slot on end of shaft for nicks and burrs.

4. Inspect the oil passage in the threaded end of the shaft and journal to insure it is not plugged.

Installation

1. Apply a light coat of oil to the journals and gear of the auxiliary shaft and position the auxiliary drive shaft in the cylinder block.

2. Install oil pump driving gear key in position on threaded end of auxiliary shaft.

3. Hold shaft in position and install the oil pump driving gear. Secure in position by installing the tabbed lockwasher and nut. Torque nut and lock by bending tabs.

4. Install new compressor oil tube using tool J21910.

5. Complete assembly by installing tachometer drive, compressor and power steering pump.

NOTE

It is good assembly procedure to back the thrust button out before installing the timing gear cover.

Adjusting Auxiliary Shaft End Play

1. Clean threads of thrust button and back locknut out toward allen head. This will insure the thrust button will bottom auxiliary drive shaft before locknut contact timing gear cover.

2. Run thrust button in until it bottoms against the auxiliary driveshaft. Turn an additional turn on thrust button to insure auxiliary shaft is against the thrust plate.

3. Snug but do not tighten locknut against the timing gear cover.

4. Back out the thrust button assembly and insert proper feeler gauge between the locknut and timing gear cover.

5. Adjust the proper shaft end play by turning thrust button assembly in or out.

6. After the proper end play has been established, remove feeler gauge and securely hold thrust button assembly and lock adjustment by running locknut against the timing gear cover.

Tachometer Drive Assembly

Inspect tachometer shaft for wear and gear for chipped, cracked or broken gear teeth. Check housing bore for wear and flange for straightness and condition of holes.

Lubricate tachometer shaft and gear and position in tachometer housing.

Install tachometer drive assembly and gasket on auxiliary drive housing. See Figure 2-334.

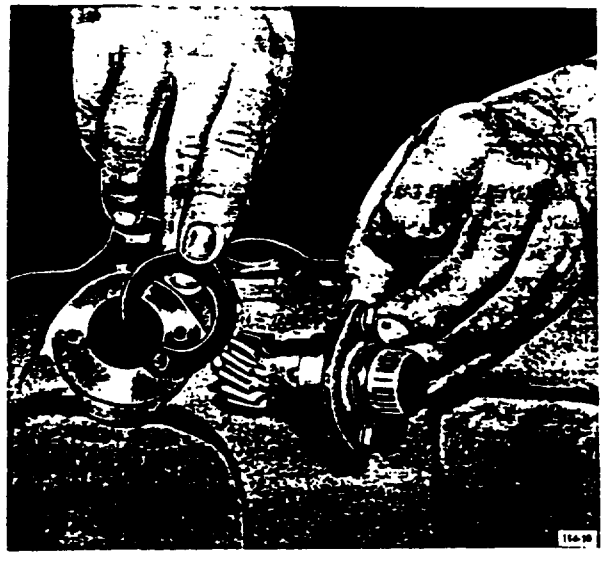


Figure 2-334. Installing Tachometer Drive Assembly

INJECTION PUMP DRIVE ASSEMBLY

Description

The injection pump drive assembly consists of an aluminum drive housing, a shaft with integral flange and tangs, driven gear and injection pump drive hub. See Figure 2-335.

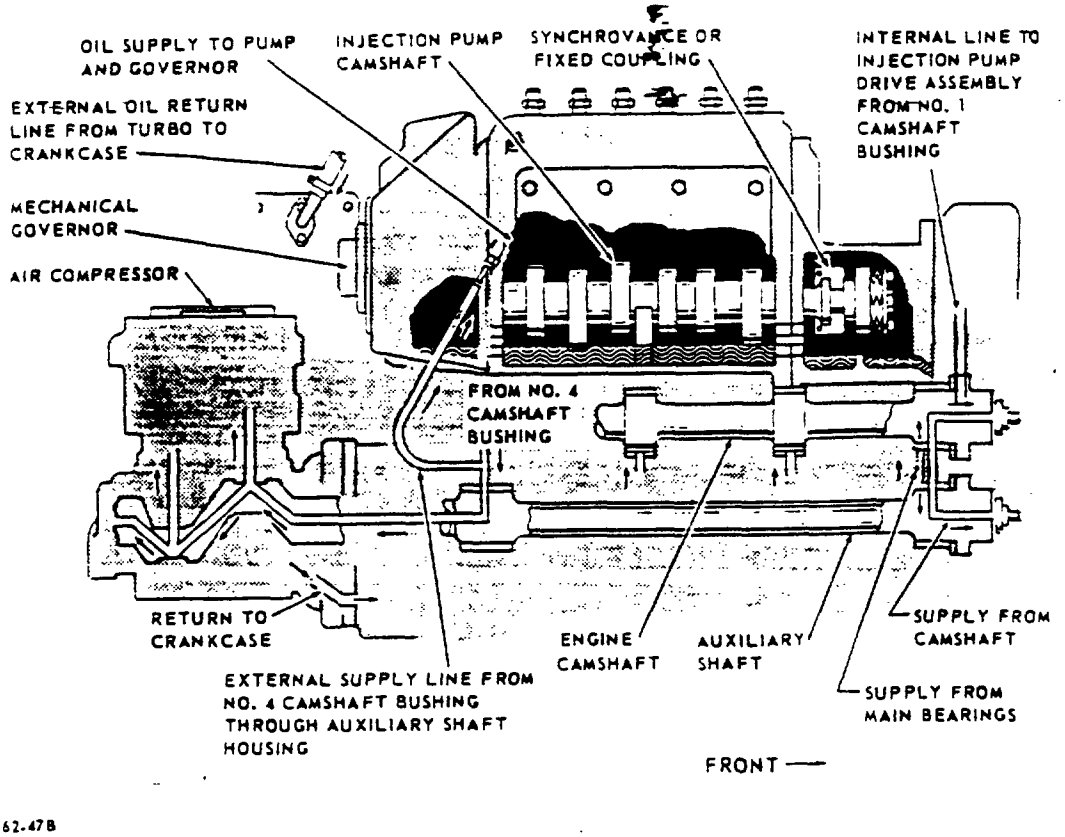


Figure 2-378. Auxiliary Drive and Injection Pump Lubrication

OIL PAN

Inspection

Inspect oil pan for dents, cracks and condition of flange, bolt holes for elongation and baffle for security. Inspect drain hole for condition of threads.

Installation

Position gasket on oil pan and position oil pan on cylinder block. Install and tighten oil pan retaining capscrews evenly to prevent oil leakage.

CYLINDER HEAD STUDS

Inspection

Check cylinder head studs for condition of threads, and straightness of shank.

Installation

Apply a light coat of lubricating oil to threads of studs and install them in cylinder block finger-tight, then back off 1/3 turn.

CYLINDER HEAD INSTALLATION

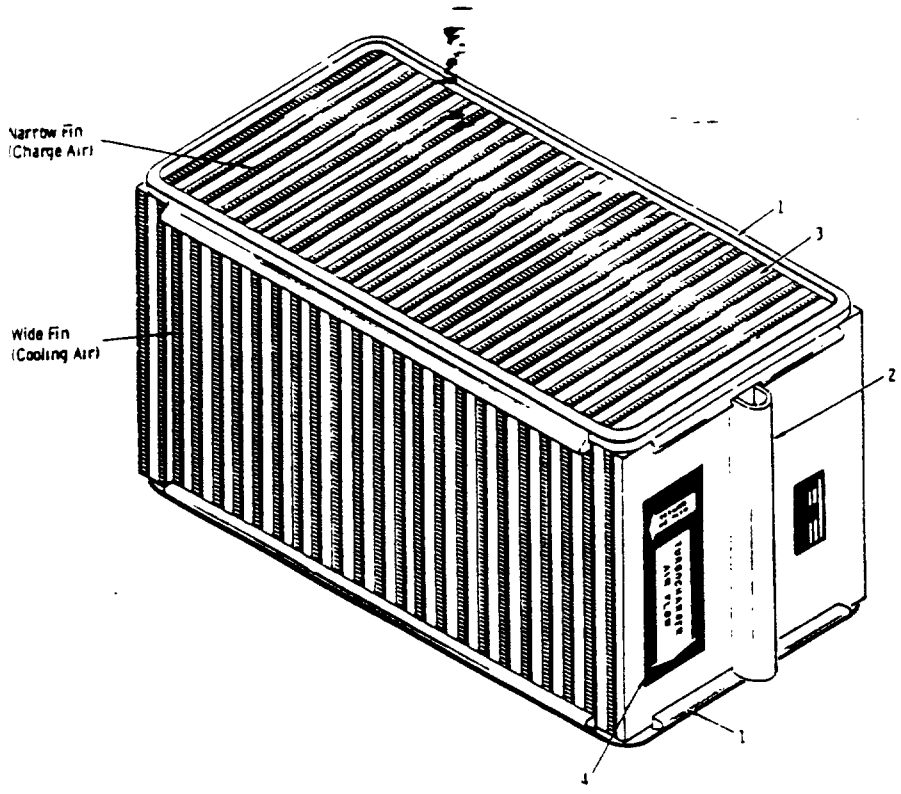
CAUTION

New cylinder head gaskets and fire rings must be installed each time cylinder heads are removed.

Place cylinder head gasket over studs on cylinder block. Besure that all passages are open and not blocked by gasket. Make sure fire rings are properly positioned. Cylinder gaskets are precoated; no soaking, coating or sealants are required. Use gaskets as received.

Position cylinder head over studs and gently onto cylinder block. See Figure 2-379. Be sure no foreign material is in cylinder.

Apply a light coat of oil to the cylinder head stud washers and nuts and install in position. Torque cylinder stud nuts in progressive steps of 50 lb. ft. using proper tightening sequence. See Figure 2-380.



1. Gasket
2. End "D" Seal
3. Core Assembly
4. Decal

Figure 2-387. Intercooler Core Assembly

Cleaning

The cooling side of the intercooler core can be cleaned by either of the following methods:

1. Steam Cleaning.

CAUTION

Steam pressures above 40 psi and/or temperatures above 400 degrees F. can damage core and gaskets.

2. Detergent Cleaning.

Use a solution of household laundry detergent. Flush through the core several times followed by a rinse with warm water. Use low pressure air to blow dry.

CAUTION

Do not under any circumstances use strong caustic solutions, i.e., "Oakite" or acid, i.e., hydrochloric acid, bowl cleaners, etc., as they will corrode the core and damage gasket. Also do not use shop solvents to clean core as gasket damage will result.

Seal Removal

1. Pull off old gaskets.

2. With a razor blade or sharp knife, cut away excessive bonding material.

NOTE

It is not necessary to remove all the bonding material out of the depressed areas since the new gasket will seal perfectly to the slightly uneven old gasket surface.

3. Remove all loose shavings and cuttings.

Seal Replacement

NOTE

Unit must be clean and dry before attempting seal replacement.

1. Place unit on flat work bench, gasket surface up. (Turbocharger airflow arrow up or down.)

2. Soak clean rag with alcohol or trichlorethylene, and swab old gasket surface and new gasket to remove all oily residue.

3. Run a "bead" of bonding agent all around the surface to be gasketed, leaving no open gaps.

4. Place gasket on core and adjust into place.

CAUTION

Refer to diagrams on gasket shipping container for proper installation position.

5. Invert the intercooler and repeat 2, 3 and 4 for the second gasket.

NOTE

If the end seals are damaged, proceed with steps 6 and 7; otherwise, omit these steps and proceed with 8.

6. Swab the end plates of the intercooler with alcohol or trichlorethylene. Swab the new end seals with alcohol or trichlorethylene.

7. Run a double bead of bonding agent on the end seals and press into place on the end plates. Hold the end seals in position with string or tape wrapped around the entire unit.

8. Check all the gaskets to make sure they have not shifted during handling.

NOTE

Gaskets may be adjusted during the first 5 minutes while the bonding agent is curing.

9. Let the entire unit stand undisturbed for 1-1/2 hours minimum before installing.

Visually inspect the bond to make sure that the gasket is firmly attached all the way around. Gaps which are found should be filled with additional bonding agent. Let cure.

NOTE

Wipe manifold or gasket surfaces with talcum powder or Dow Corning 44 silicone grease before installing in manifold to prevent gasket sticking.

NOTE

Do not use petroleum base grease or oil for this purpose.

WATER PUMP

Description

The water pump is a centrifugal-rotor type, V-belt driven from the crankshaft. The pump cover contains the grease cavity and provisions for single and double row ball bearings which support the shaft. The bearings are sealed on one side to retain grease. A vent fitting replaces the usual grease fitting because the initial pack of grease, 1/3 full, should suffice for the life of the pump. A cartridge-type water seal with synthetic rubber bellows and carbon ring form an effective water-tight seal.

The housing, which comprises the volute (rotor casing) and water outlet to the engine is also the pump mounting.

It is usually more economical to obtain a rebuilt exchange water pump than to overhaul the old one. Contact your Mack Branch or Distributor for rebuilt exchange water pumps.

INJECTION PUMP INSTALLATION

1. Bar engine in normal direction of rotation until No. 1 cylinder is on compression stroke and flywheel timing mark indicates correct number of degrees BTC recommended on valve cover escutcheion plate. The injection pump driveshaft flange lugs should now be in a horizontal plane and indexing pin hole at 4 o'clock position, looking at face of shaft flange.

2. Grease front (non-counterbored) face of coupling and mount on pump driveshaft flange with long end of offset indexing pin pointing rearward and center the coupling ring laterally.

3. Remove pump adapter inspection hole cover.

4. Rotate pump coupling driven flange until lugs are in a vertical plane and indexing hole is at 7 o'clock position, looking from drive end of pump. See Figure 2-389.

Installation - See Figure 2-392.

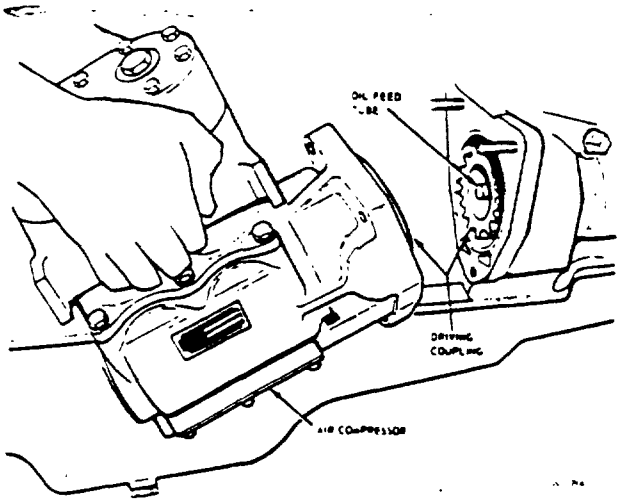


Figure 2-392. Installing Air Compressor

The oil transfer tube is assembled loose at both ends of auxiliary driveshaft.

Place silastic on air compressor mounting face and position on auxiliary housing. Install and torque air compressor retaining capscrews.

WARNING

Recheck auxiliary shaft end float after installing air compressor.

FUEL INJECTION LINES, High Pressure

Description

Fuel injection lines are seamless cold-drawn high tensile steel. All lines on one engine are of identical length and inside diameter.

Inspection

Inspect fuel injection line for chafing, dents, nicks or sharp bends. Check fittings, seat and threads for condition. Check lines to be sure they are not restricted.

Installation

Install fuel injection nozzles. Install fuel injection lines and be sure brackets are properly positioned to prevent lines from chafing.

The lines should fit without difficulty if they have not been changed around. NEVER BEND THE LINES TO MAKE THEM FIT.

Torque fuel injection lines at injection nozzles and pump locations. Torque injection line brackets.

INTAKE MANIFOLD

Description

Cast aluminum manifold provides the distribution point of the turbocharged aftercooled air and seat for the intercooler core. An integral part of the manifold is the front water manifold. This design feature permits the use of one compact and simple housing.

The thermostat housing is placed in the inlet end of the front water manifold. The coolant conditioner bolts to the flange of the front water manifold.

Inspection

Inspect intake manifold for restrictions. Check mounting flanges for erosion, cracks and straightness.

Installation

Place new gaskets between intake manifold and cylinder head. Install and tighten attaching capscrews to the proper torque.

EXHAUST MANIFOLD

Inspection

Inspect the exhaust manifold for restrictions. Check mounting flanges for erosion, cracks and straightness.

Installation

Place new gaskets between exhaust manifold and cylinder head. Install and tighten the attaching washers and nuts to the proper torque.

ROCKER ARM COVERS

Inspection

Inspect rocker arm covers for cleanliness, dents and straightness of flange. Check breather in cover, if applicable, to be sure it is not plugged.

Installation

Cement new gasket to mounting flange of rocker arm cover.

Position cover over rocker arms; install and torque cover retaining capscrews or nuts as applicable.

TURBOCHARGER

Description

The turbocharger is an exhaust gas driven air compressor. See Figure 2-393. The purpose of the turbocharger is to increase the supply of air to the cylinders and thus burn more fuel which in turn produces more power.

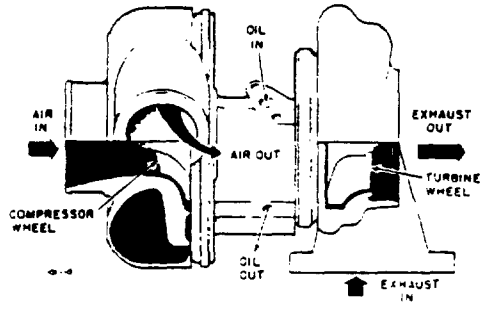


Figure 2-393. Exhaust Driven Turbocharger

The turbocharger consists of three main parts; the turbine housing, the bearing housing and the compressor housing. The turbine housing is located at one end of the bearing housing and the compressor housing is located at the other end. A common shaft connects the turbine wheel and compressor wheel.

The turbine end of the turbocharger uses exhaust gas energy normally discharged to the atmosphere. The exhaust gas enters the turbocharger through the flange connection on the exhaust manifold. The exhaust gas flows around the turbine housing and radially inward causing the turbine wheel to rotate. The exhaust gas is then discharged through the center of the turbine housing into the exhaust pipe.

The bearing housing contains the through-shaft, bearings, seals and oil passages.

The bearings are of the floating sleeve type and are pressure lubricated from the engine oil supply system. Piston ring type oil seals are used at each end of the shaft to effectively seal off the oil.

The compressor housing contains the compressor wheel and air enters at the center of the compressor wheel and flows radially outward into the compressor housing. The air leaves through a tangential outlet on the outside of the compressor housing and is ducted to the inlet manifold.

Checks Before Removal

If turbocharger malfunction is suspected, make the following checks before removal of turbocharger from the engine:

1. Start engine and check for unusual noise or vibration from turbocharger. This will indicate out-of-balance, rubbing or damage to compressor turbine wheels.

2. Check for leaks in the air system from turbocharger to intake manifold and from intake manifold to cylinder block. Be sure all bolts, clamps and connections are tight and gaskets are not blown and are in proper location.

3. Check air cleaner and air intake system, from the air cleaner to turbocharger, for restrictions to air flow or leaks.

4. Check exhaust system, from cylinder block to turbocharger, for exhaust leaks. Be sure all bolts, clamps and connections are tight and gaskets are not blown and are in proper location.

5. Check exhaust system from turbocharger to outlet for restrictions.

6. Check turbine wheel for radial and axial looseness. If radial and/or axial looseness is excessive, the turbocharger will have to be removed for overhaul. If turbocharger has to be overhauled, consult your Mack Branch or Distributor for details on turbocharger exchange program.

Cleaning

The compressor end of the turbocharger should be cleaned after 1000 to 2000 hours of operation. If the compressor wheel is not too dirty, it can be cleaned with the turbocharger on the engine.

Disconnect compressor discharge flange; remove the capscrews or clamp ring that holds the compressor housing to the bearing housing, and pull compressor housing carefully along turbocharge axis to prevent damage to the compressor wheel or the diffuser.

Use Bendix Metal Cleaner or equivalent solvent to clean compressor wheel. Do not use a caustic solution or any other type that may attach aluminum, as this will either weaken the impeller or destroy its balance. Do not use a wire brush or scraper; a brush with nylon or hog bristles is preferred.

If compressor wheel is found to be very dirty, remove turbocharger from the engine for cleaning. With compressor housing removed, immerse compressor wheel into the cleaning fluid and allow to soak. Use care not to rest weight of turbocharger on compressor wheel or on end of shaft.

The turbine end of turbocharger can be cleaned only after removal from the engine and separation of the bearing housing from the turbine housing.

Installation Guide

Use the following steps as a guide when installing turbocharger to engine:

1. Inspect air intake system for cleanliness, leakage and foreign material.

2. Inspect exhaust manifold for foreign material.

3. Inspect oil drain line to be sure it is not clogged or restricted.

4. Inspect oil supply line for restriction, deterioration or possibility of leaking under pressure.

5. Inspect turbocharger mounting pad, on exhaust manifold, for erosion, flatness and to be sure old gasket is removed.

6. Place new gasket on exhaust manifold, position turbocharger and install attaching bolts.

7. Connect oil inlet line and oil drain line to turbocharger.

8. Connect compressor inlet and outlet piping. Check to be sure all clamps and bolts are tight. Be sure piping is not producing strain on compressor cover.

9. Crank engine, without firing, until a steady flow of oil is noted coming from the oil drain outlet of the turbocharger.

10. Stop cranking engine and connect oil drain line to engine. Be sure drain line slopes downward throughout its length with no sharp bends or kinks.

TIP TURBINE FAN AIR INTAKE SYSTEM

Description

A stratatube air separator provides clean air to the tip turbine fan and intercooler core. Outside air is drawn through the stratatube separator before entering the tip turbine fan. A bleed off type ejector pulls the dirty air from the separator. See Figure 2-394.

The stratatube air separator has no moving parts. All incoming air hits the fixed vanes in the separator and is swirled. The heavier, dirty air is forced to the outside of the vanes; while the lighter, cleaner air exits through the center. Bleed air from the inlet manifold enters the ejector, creating a partial vacuum which pulls the dirty air out of the separator and exhausts it into the atmosphere.

Maintenance

Basically, the stratatube air separator requires no maintenance other than a routine visual inspection making sure all parts are open and all connections tight.

Valve Seat Inserts

The inlet and exhaust valve seat inserts are identical except for diameter. Seat angle is 30 degrees -0'/+30'. Seating width is 1/16 to 3/32 in. Maximum seat runout is 0.0015 in. See Figure 2-398.

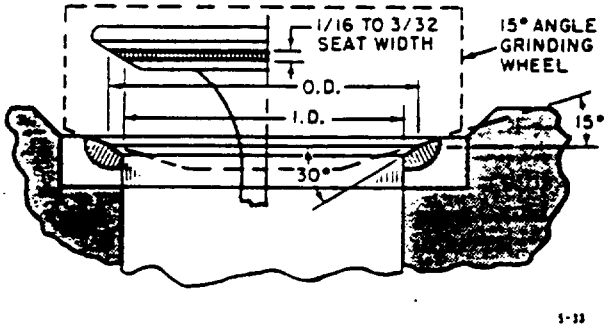


Figure 2-398. Valve Seat Dimensions

Press fit of inlet and exhaust valve seat inserts in head is 0.0025 to 0.0045 in. Standard inlet valve seat insert O.D., 2.4405 to 2.4415 in. Bore in head for standard inlet valve seat insert, 2.437 to 2.438 in. Standard exhaust valve seat insert O.D. is 2.0855 to 2.0865 in. Bore in head for standard exhaust valve seat insert is 2.082 to 2.083 in.

Valve seat inserts are available in 0.015, 0.031, 0.047, and 0.062 in. oversizes. Shrink inserts in dry ice for 20 minutes prior to installation in head.

Valve Guide

Inlet and exhaust valve guides are made of a special iron. Valve guide bore in cylinder head is 0.6860 to 0.6870 in. Outside diameter of valve guides is 0.6881 to 0.6886 in. Press fit of valve guides in head is 0.0011 to 0.0026 in. Press guides into head until top of guide extends above valve spring seating surface 1-35/64 in. See Figure 2-399.

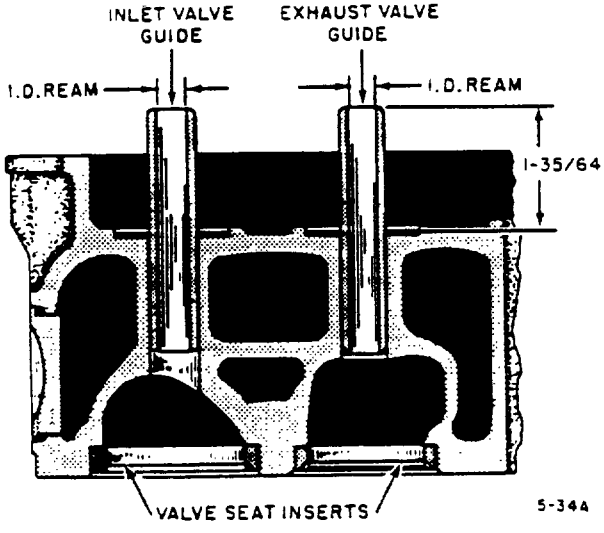


Figure 2-399. Valve Guides

Inlet Valve

Poppet type, chrome-silicon steel. Valve face angle, 30 degrees, +0'/-30'. Reamed I.D. of inlet valve guide, 0.4995 to 0.5005 in. Valve stem diameter, 0.4965 to 0.4975 in. Stem-to-guide clearance (service), 0.002 to 0.004 in. Maximum face runout (service), 0.0015 in. Stem-to-rocker arm lash setting, 0.016 in. cold static, 0.014 in. hot idle. Install new oil seals, shields and keys at overhaul.

Exhaust Valve

Poppet type. Valve face angle, 30 degrees +0'/-30'. Reamed I.D. of exhaust valve guide, 0.4995 to 0.5005 in. Valve stem diameter, 0.4955 to 0.4965 in. Stem-to-guide clearance (service), 0.003 to 0.005 in. Maximum face runout (service), 0.0015 in. Stem-to-rocker arm lash setting, 0.024 in. cold static, 0.022 in. hot idle. Use new valve rotators and keys at overhaul.

Inner Valve Spring

Nominal free length, 3-1/32 in. Test for 82.1 to 90.7 lbs. when compressed to 2-1/32 in. Service limit, 77.2 lbs.

Outer Valve Spring

Nominal free length, 3-13/32 in. Test for 105.3 to 116.3 lbs. when compressed to 2-5/32 in. Service limit, 99 lbs.

Rocker Arm Shaft

Shaft O.D., 1.1286 to 1.1291 in. Drilled for bottom oil feed of rocker arms. Locating screw assures proper line-up of oil passage.

Rocker Arm

Ratio, 1.8 to 1. Shaft hole diameter, 1.1296 to 1.1301 in. Hole-to-shaft clearance is 0.0005 to 0.0015 in.

Before installing rocker arm and shaft assembly on cylinder head, be sure to fit O-ring carefully in recess at oil passage-to-rocker arm bracket on top of cylinder head.

Rocker arm bracket capscrew torque, 55 lb. ft.

Cylinder Head Installation

Each cylinder head is secured to the cylinder block by twenty 5/8 in. diameter studs, flat washers and nuts. Use new studs and manifold capscrews at overhaul.

Oil the coarse stud threads lightly with SAE 30 engine oil. Insert studs finger-tight into block until bottomed, then back them off 1/3 turn. Wipe deck surface to remove oil, etc. Place cylinder head gaskets in their proper positions on the block checking that the rubber seals are correctly positioned in holes of gasket.

NOTE

Do not water soak or use sealing compounds or other coatings on gasket, block or head surfaces.

Set cleaned cylinder heads in place separately. When in place, apply Permatex No. 2 to the accessible outer edges of gasket. Lightly oil all cylinder head stud nut bosses, stud and nut threads and washers with engine oil. Install washers and nuts finger-tight. Assemble manifolds using new gaskets, but do not tighten nuts and capscrews until after heads have been torqued. Tighten all cylinder head stud nuts, one head at a time, using the following procedure. See Figure 2-400.

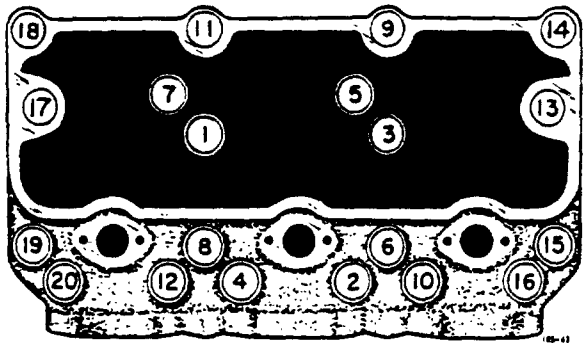


Figure 2-400. Cylinder Head Stud Nut Tightening Sequence

Tighten all stud nuts to 50 lb. ft. torque following sequence in Figure 5. Tighten again in sequence, to 100 lb. ft. torque. Tighten finally, in sequence, to 175 lb. ft. When all stud nuts have been tightened to their specified torque, the top of the stud should be flush to three threads above the top of the nut. After engine run in, cylinder head stud nuts must be retorqued. Refer to Mack Piston Ring set package for run-in procedure.

CYLINDER BLOCK

Chrome-nickel alloy. An integral water manifold distributes cool water around the upper area of the water jacket. The cylinders are bored to take dry type cylinder liners. The deck area surface must be flat within 0.0015 in. Excessively eroded water holes developing at deck area must be repaired. Drill, tap and install bronze plug. Mark center using cylinder head gasket as a template and drill new water hole. Finish plug off flat with deck surface. Do not mill deck surface if piston head will protrude more than 0.018 in. above cylinder deck surface. Remove all core hole plugs to remove rust scale and silt deposits from water compartments. Use new O-rings and coat with sealing compound National Machine Products Oil and Water Sealer, or equivalent, when reinstalling plugs.

Cylinder Liner

Dry type, special alloy iron, Rockwell C43-53. Part number etched on barrel. Standard size O.D., 5.1565 to 5.1575 inches. Cylinder liner I.D. for standard size piston, 5.0010 to 5.0020 inches to produce fit of 0.000 to 0.001 inches press.

Shoulder extension, 0.0035 to 0.0075 in. above deck. Extension of liners under same head should be within 0.001 in. Liners available in 0.002, 0.004, 0.006, 0.012 and 0.020 in. O.D. oversizes. Maximum out-of-round or taper of cylinder bore for liner, 0.002 in.

When replacing cylinder liners, check cylinder block bore. If out-of-round or taper does not exceed 0.006 in., hone block for 0.002, 0.004, or 0.006 in. oversize liner as required. If out-of-round or taper exceeds 0.006 in., bore cylinder block for 0.012 in. or larger oversize liner as required.

Main bearing caps must be in place and capscrews must be torqued when cylinder block is honed or bored.

Maximum permissible out-of-round or taper of cylinder liner bore is 0.002 in. Remove honing grit by swabbing bore with a cloth saturated with clean SAE 10 oil. Remove all traces of oil with solvent and blow dry with clean, dry compressed air. If liner enters 1/2 to 2/3 of the bore, a light press on top of liner should suffice. Stop pressing when liner is 1/2 in. from deck, clean counterbore

Outer Valve Spring

Nominal free length, 3-13/32 inch. Test for 105.3 to 116.3 lbs. when compressed to 2-5/32 inch. Service limit, 99 lbs.

Rocker Arm Shaft

Shaft O.D., 1.1286 to 1.1291 inch. Drilled for bottom oil feed of rocker arms. Locating screw assures proper line-up of oil passage.

Rocker Arm

Ratio, 1.8 to 1. Shaft hole diameter, 1.1296 to 0.0301 inch. Hole-to-shaft clearance is 0.0005 to 0.0015 inch.

Before installing rocker arm and shaft assembly on cylinder head, be sure to fit O-ring carefully in recess at oil passage-to-rocker arm bracket on top of cylinder head.

Rocker arm bracket capscrew torque, 35 lb. ft.

Cylinder Head Installation

Each cylinder head is secured to the cylinder block by twenty 5/8 inch diameter studs, flat washers and nuts. Use new studs and manifold capscrews at overhaul.

Oil the coarse stud threads lightly with SAE 30 engine oil. Insert the studs finger-tight into block until bottomed, then back them off 1/3 turn. Clean sealing grooves in head surface and liner flanges using a brass wire rotary brush. Absolute cleanliness of essential. Wipe deck surface to remove oil, etc. Place cylinder head gaskets and fire rings in their proper positions on the block.

NOTE

New cylinder head gaskets and fire rings must be installed each time the cylinder heads are removed. Do not water soak or use sealing compounds or other coatings on gasket, block or head surfaces.

Check cylinder head deck surface and fire ring groove to be sure they are clean and free of carbon. Set cleaned cylinder heads in place separately. Lightly oil all cylinder head stud nut bosses, stud and nut threads and washers with engine oil. Install washers and nuts finger-tight. Assemble manifolds using new gaskets, but do not tighten nuts and capscrews until cylinder heads are torqued down. Tighten all cylinder head stud nuts, one head at a time, using the following procedure. Tighten all stud nuts to 50 lb. ft. torque following sequence in Figure 2-414. Tighten again, in sequence, to 100 lbs. ft. torque. Tighten finally, in sequence, to 175 lb. ft. When all stud nuts have been tightened to their specified torque, the top of the stud should be flush to three threads above the top of the nut. After engine run in, cylinder head stud nuts must be retorqued. Refer to Mack Piston Ring set package for run in procedure, and do not deviate from it.

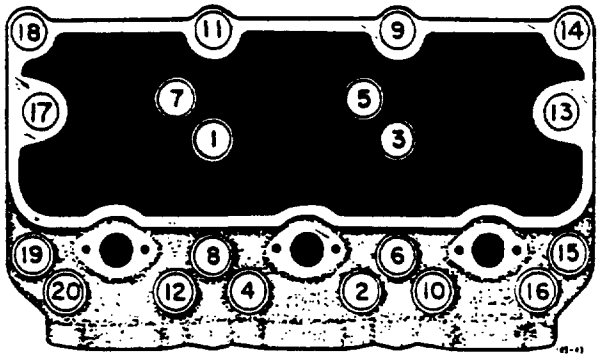


Figure 2-414. Cylinder Head Stud Nut Tightening Sequence

CYLINDER BLOCK

The cylinder block is an alloy casting with an integral cast water manifold to distribute coolant around the upper area of the block. Drilled passages are incorporated for transfer of coolant to the cylinder head and the proper distribution of lubricating oil to the various parts of the engine. The cylinders are bored to take dry cylinder liners. The deck area surface must be flat within 0.0020 inch under area covered by individual head. Excessively eroded water holes at deck area must be repaired. To repair these holes, drill, tap and install bronze plug. Complete repair by drilling a new water hole using cylinder head gasket as template. Finish plug off flat with deck surface. Do not mill deck surface if piston head will protrude more than 0.018 inch above cylinder deck surface. Remove all core hole plugs to remove rust scale and silt deposits from water compartments. Use new O-rings and coat with sealing compound National Machine Products Oil and Water Sealer, or equivalent, when reinstalling plugs.

A machined oil pad is provided on the left hand side of the cylinder block. Porting in the pad corresponds to the porting in the oil pressure relief valve assembly.

5. Press gear and shaft assembly into bearing until it bottoms on shoulder on shaft.

6. Invert housing and gear and install spacer.

7. Install rear bearing with seal side outward in housing.

8. Clamp assembly in a suitable clamping fixture to hold gear and install water pump drive shaft screw. Tighten to recommended torque.

9. Install O-ring in the groove on outer periphery of the housing.

10. Lubricate O-ring seal generously and install drive assembly in cylinder block recess with flat side of housing toward camshaft gear.

NOTE

It is important to generously lubricate O-ring seal before installing in block. This will prevent the O-ring from rolling on upper surface and restricting oil supply to the water pump bearings.

11. Install three water pump housing capscrews securing assembly in position. Tighten to recommended torque.

TIMING GEAR COVER

Inspection

Inspect timing gear cover for dents, condition of threaded holes and straightness of flanges.

Installation

1. Install crankshaft front oil seal into the cover using tool J-21375.

2. Install the adjustable camshaft thrust button from the inside and position the washer and jam nut on the outside of the cover.

3. Adjust camshaft thrust button to its retracted position.

4. Install six guide studs. Two guide studs are used at the lowest point, highest point and one adjacent to the water pump drive and the final stud adjacent to the drive provision directly opposite the water pump drive.

5. Install the timing gear gasket over guide studs.

6. Install the timing gear cover over the guide studs and push cover into position.

7. Install all cover capscrews loosely.

8. Install water pump drive alignment tool J-21382 and crankshaft oil seal alignment tool J-21381. Torque all capscrews.

CRANKSHAFT VIBRATION DAMPER AND HUB

Inspection

1. Inspect crankshaft vibration damper hub for scoring, condition of flange, threaded holes and keyway.

2. Inspect the vibration damper for general condition, mounting threaded holes and housing.

Installation

1. Position crankshaft keyway UP and install key.

2. Heat crankshaft vibration damper hub in hot oil to 250 degrees F.

3. Align crankshaft hub on key and install hub. See Figure 45.

Installation

1. Time auxiliary drive to camshaft gear. Install both push rods in No. 6 cylinder location. Bar engine over until movement is felt in both push rods simultaneously and the timing indicator pointer indicates TDC for No. 1 and 6 cylinders. The single punch mark on the camshaft gear will be in the upright position.

2. Install O-ring in oil passage port at right hand front top edge of cylinder block.

3. Apply a bead of 243SX32 gasket compound or equivalent to mating surfaces of the auxiliary drive housing.

4. Place auxiliary housing assembly on top of the block carefully.

NOTE

Be sure timing gear cover gasket is properly positioned and the single timing mark on the camshaft gear alignes with the single timing mark on the auxiliary drive gear.

5. Install all nine capscrews and washers hand tight.

6. Torque the two lower timing gear cover to auxiliary housing capscrews.

7. Torque all auxiliary housing to cylinder block capscrews.

8. Release the torque on the two timing gear cover to auxiliary housing capscrews then retorque the same capscrews.

NOTE

This procedure will align auxiliary housing to front face of the cylinder block and permit block surface to butt fully to mating surface of auxiliary housing.

9. Check backlash between camshaft gear and auxiliary drive gear. If backlash is not within limits, loosen auxiliary housing capscrews and reposition housing by tapping with a soft faced mallet. Retorque capscrews and recheck backlash.

NOTE

Care must be taken at this time to have all pipe plugs in the auxiliary drive oil gallery passages. Access to these plugs becomes increasingly difficult at later assembly points.

VALVE LIFTER COVERS

The center valve lifter cover is a steel stamping and requires a new gasket at assembly. The rear valve lifter cover is cast aluminum. At assembly apply a bead of gasket compound 243SX32 to the cover and cylinder block mating area.

INJECTION PUMP

Installation

1. Bar engine over in the normal direction of rotation until the No. 1 cylinder piston is at TDC, as indicated by the timing indicator, and the timing marks on the auxiliary drive shaft gear aligns with the timing mark on the auxiliary drive idler. The pin hole location will be at the five o'clock position and the coupling tangs are at 12 degrees 36 minutes off the horizontal. See Figure 48.

2. Bar engine back approximately 40 degrees.

3. Bar engine over in the normal direction of rotation until timing indicator reads the B.T.C. setting as specified on the injection pump name plate. In this position the tangs on the drive coupling will be approximately horizontal and the drive coupling pin hole will be approximately at the 4:30 o'clock position. The gear marks will be approximately 15 degrees 30 minutes to the right. See Figure 50.

CYLINDER HEAD INSTALLATION

NOTE

New cylinder head gaskets and fire rings must be installed each time cylinder heads are removed.

1. Clean the cylinder block deck thoroughly.

2. Install new cylinder head gasket on deck. Position of gasket is determined by guide pins in the upper deck.

NOTE

Do not use a sealing compound or soak cylinder head gaskets. They are all pre-coated.

3. Install new fire ring carefully fitted over circular bead on cylinder sleeve flange. See Figure 55.

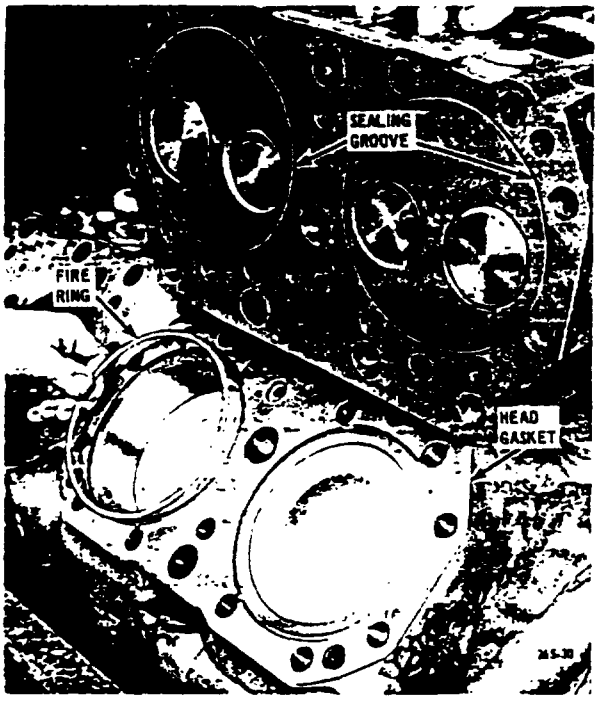


Figure 55. Cylinder Head Installation

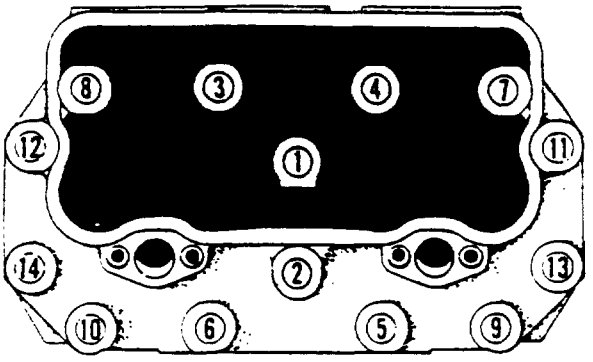
4. Clean the surface of the cylinder head and ciruclar groove for the fire ring.

5. Carefully position the cylinder head assembly over the cylinder block deck aligning the guide pins in the block with the guide holes in cylinder head.

6. Install cylinder head on block.

7. Install fourteen cylinder head capscrews.

8. Torque capscrews on each head progressively in steps of 50 to 100 to 175, and finally to 225 lb. ft. in sequence as shown. See Figure 56.



Cylinder Head Nut Tightening Sequence
ENDT865

Figure 56. Cylinder Head Tightening Sequence

PUSH RODS

Description

The push rods for the intake and exhaust valve rocker arms are tubular steel with spherical ends. Engines not fitted with the Dynatard engine brake feature identical 1/2 inch O.D. x 14-1/4 inch push rods; however, when the engine is fitted with the Dynatard engine brake system the exhaust valve rocker arm push rod is heavier 5/8 inch O.D. x 14-1/4 inch long.

Inspection

1. Inspect and check the push rods for length and straightness. Replace any that are bent.

2. Inspect and check the spherical surfaces for wear and tightness to tube.

Installation

Apply a light coat of lubricating oil to the spherical ends and install the push rods in the valve lifters.

4. Continue adjusting valve lash for the remaining cylinder pistons in firing order placing each cylinder piston at TDC with respective 1/4 turns of the engine crankshaft.

5. Properly secure aduusting screw locknut after each cylinder piston valve lash adjustment.

To Adjust Valve Lash Hot Idle (Not Recommended for Engines with the Dynatard Engine Brake System)

1. Start engine and warm up to normal operating temperature.

2. Set valve lash at hot idle (600 to 650 rpm) inlet valve 0.015 inch, exhaust 0.024 inch.

3. Properly secure adjusting screw lock nut after each cylinder piston valve lash adjustment.

WATER OUTLET MANIFOLD

Inspection

1. Inspect water outlet manifold for restrictions.

2. Inspect and check mounting flanges for cracks and straightness.

Installation

1. Place new gasket between right bank and left bank water manifold and the mating cylinder heads.

2. Install and tighten attaching capscrews to the proper torque.

3. Install thermostats in the right and left bank water manifolds.

4. Install thermostat gaskets, water outlet fittings, thermostat seals and water outlet by-pass elbows.

5. Secure assembly to the water manifold by installing the attaching capscrews.

INLET MANIFOLD

Inspection

1. Inspect and check the inlet manifolds for restrictions.

2. Inspect and check mounting flanges for erosion, cracks and straightness.

Installation

1. Place new gaskets between the inlet manifold and cylinder head.

2. Install right and left hand inlet manifolds and lifting eyes. Secure to cylinder head by installing attaching capscrews and tighten to the recommended torque.

3. Place a new inlet manifold fitting gasket on the top of each inlet manifold and install inlet manifold inlet fitting.

4. Install tee fitting and complete inlet manifold assembly.

EXHAUST MANIFOLD

Inspection

1. Inspect and check the exhaust manifold for restrictions.

2. Inspect and check the mounting flanges for erosion, cracks and straightness.

Installation

1. Place new gaskets between exhaust manifold and cylinder head.

2. Install and tighten the attaching capscrews and washers to the proper torque.

CYLINDER HEAD COVERS

Inspection

1. Inspect and check the cylinder head covers for cleanliness, dents and straightness of flange.

6. Check turbine wheel for radial and axial looseness. If radial and/or axial looseness is excessive, the turbocharger will have to be removed for overhaul. If turbocharger has to be overhauled, consult your Mack Branch or Distributor for details on turbocharger exchange program.

Cleaning

The compressor end of the turbocharger should be cleaned after 1000 to 2000 hours of operation. If the compressor wheel is not too dirty, it can be cleaned with the turbocharger on the engine.

Disconnect compressor discharge flange; remove the capscrews or clamp ring that holds the compressor housing to the bearing housing, and pull compressor housing carefully along turbocharger axis to prevent damage to the compressor wheel or the diffuser.

Use Bendix Metal Cleaner or equivalent solvent to clean compressor wheel. Do not use a caustic solution or any other type that may attack aluminum, as this will either weaken the impeller or destroy its balance. Do not use a wire brush or scraper; a brush with nylon or hog bristles is preferred.

If compressor wheel is found to be very dirty, remove turbocharger from the engine for cleaning. With compressor housing removed, immerse compressor wheel into the cleaning fluid and allow to soak. Use care not to rest weight of turbocharger on compressor wheel or on end of shaft.

The turbine end of turbocharger can be cleaned only after removal from the engine and separation of the bearing housing from the turbine housing.

Installation Guide

Use the following steps as a guide when installing turbocharger to engine.

1. Inspect air intake system for cleanliness, leakage and foreign material.

2. Inspect exhaust manifold for foreign material.

3. Inspect oil drain line to be sure it is not clogged or restricted.

4. Inspect oil supply line for restriction, deterioration or possibility of leaking under pressure. Be sure check valve is working properly and not restricted.

5. Inspect turbocharger mounting pad on exhaust manifold for erosion, flatness and to be sure old gasket is removed.

6. Place new gasket on exhaust manifold, position turbocharger and install attaching bolts.

7. Connect oil inlet line and oil drain line to turbocharger.

8. Connect compressor inlet and outlet piping. Check to be sure all clamps and bolts are tight. Be sure piping is not producing strain on compressor cover.

9. Crank engine, without firing, until a steady flow of oil is noted coming from the oil drain outlet of the turbocharger.

10. Stop cranking engine and connect oil drain line to engine. Be sure drain line slopes downward throughout its length with no sharp bends or kinks.

ENGINE BREAK-IN PROCEDURE AFTER OVERHAUL OR REBUILD

Comparative tests and careful review of engine break-in mehtods have proven that a short run under full load is substantially more effective than the light or no load slow speed increase type of break-in. Compatibility between the critical components (piston, rings and bores) is greatly improved by raising engine speed and applying full load immediately after warm-up.

Use the recommended type and grade engine oil and fuel as required for usual operation of the vehicle.

Immediately prior to initial starting of the engine, the fuel system, oil galleries and filters are to be primed preferably by means of a pressure tank.

Check the air intake system to be sure all joints are tight and the filter element and system are clean.

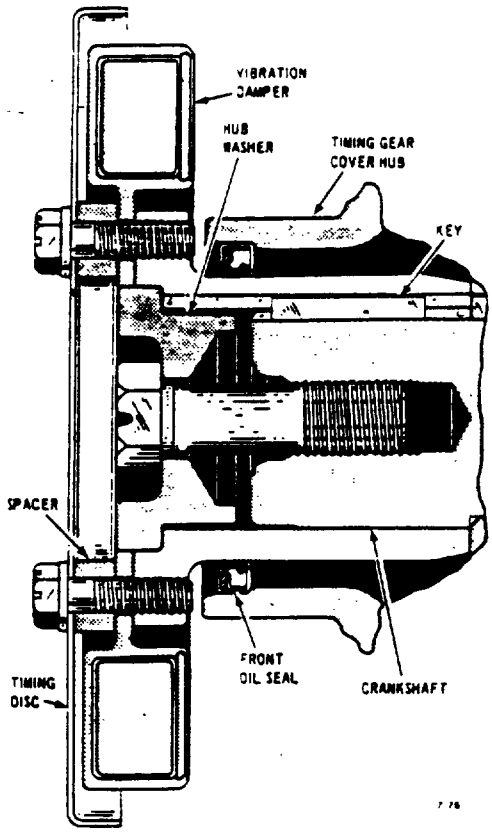


Figure 45. Vibration Damper and Hub Arrangement

4. Install hub washer and retaining screws. Torque screws.

5. Install vibration damper, spacer and timing disc on crankshaft hub; the holes will only line up one way.

6. Install retaining capscrews securing assembly.

NOTE

When all parts are assembled on the crankshaft, keyway up, the scribe mark on the damper rim must be up. The TDC mark must align with the timing indicator 30 degrees to the left of the engine centerline.

OIL PAN

Inspection

1. Inspect oil pan for dents, cracks and condition of flange.

2. Inspect and check the bolt holes for elongation and baffle for security.

3. Inspect and check drain hole for condition of threads.

Installation

1. Position gasket on oil pan and position oil pan on cylinder block.

2. Install and tighten oil pan retaining capscrews evenly to prevent oil leakage.

AUXILIARY DRIVE ASSEMBLY

Description

The auxiliary drive is a complete unit sub-assembly located between the cylinder heads on the front of the engine. The auxiliary drive consists of a drive housing, idler shaft and gear assembly and drive shaft. It is gear driven from the camshaft. See Figure 46.

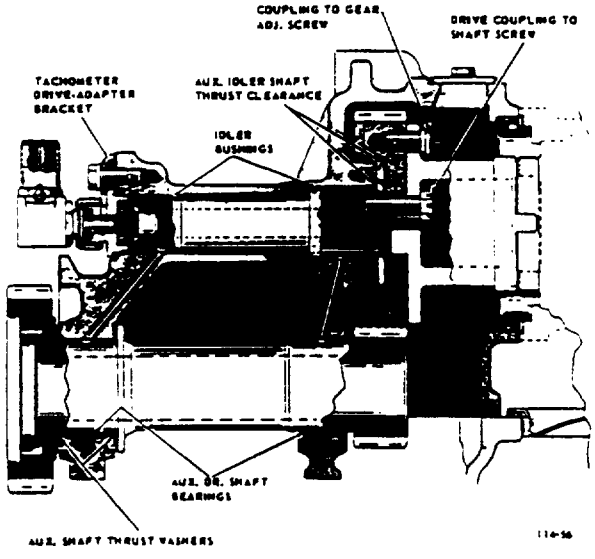


Figure 46. Auxiliary Drive Assembly

DRIVE HOUSING

Description

The auxiliary drive housing is an alloy casting and supports the drives for the injection pump, air compressor, tachometer drive and hydraulic steering pump.

Installation

1. Time auxiliary drive to camshaft gear. Install both push rods in No. 6 cylinder location. Bar engine over until movement is felt in both push rods simultaneously and the timing indicator pointer indicates TDC for No. 1 and 6 cylinders. The single punch mark on the camshaft gear will be in the upright position.

2. Install O-ring in oil passage port at right hand front top edge of cylinder block.

3. Apply a bead of 243SX32 gasket compound or equivalent to mating surfaces of the auxiliary drive housing.

4. Place auxiliary housing assembly on top of the block carefully.

NOTE

Be sure timing gear cover gasket is properly positioned and the single timing mark on the camshaft gear alignes with the single timing mark on the auxiliary drive gear.

5. Install all nine capscrews and washers hand tight.

6. Torque the two lower timing gear cover to auxiliary housing capscrews.

7. Torque all auxiliary housing to cylinder block capscrews.

8. Release the torque on the two timing gear cover to auxiliary housing capscrews then retorque the same capscrews.

NOTE

This procedure will align auxiliary housing to front face of the cylinder block and permit block surface to butt fully to mating surface of auxiliary housing.

9. Check backlash between camshaft gear and auxiliary drive gear. If backlash is not within limits, loosen auxiliary housing capscrews and reposition housing by tapping with a soft faced mallet. Retorque capscrews and recheck backlash.

NOTE

Care must be taken at this time to have all pipe plugs in the auxiliary drive oil gallery passages. Access to these plugs becomes increasingly difficult at later assembly points.

VALVE LIFTER COVERS

The center valve lifter cover is a steel stamping and requires a new gasket at assembly. The rear valve lifter cover is cast aluminum. At assembly apply a bead of gasket compound 243SX32 to the cover and cylinder block mating area.

INJECTION PUMP

Installation

1. Bar engine over in the normal direction of rotation until the No. 1 cylinder piston is at TDC, as indicated by the timing indicator, and the timing marks on the auxiliary drive shaft gear aligns with the timing mark on the auxiliary drive idler. The pin hole location will be at the five o'clock position and the coupling tangs are at 12 degrees 36 minutes off the horizontal. See Figure 48.

2. Bar engine back approximately 40 degrees.

3. Bar engine over in the normal direction of rotation until timing indicator reads the B.T.C. setting as specified on the injection pump name plate. In this position the tangs on the drive coupling will be approximately horizontal and the drive coupling pin hole will be approximately at the 4:30 o'clock position. The gear marks will be approximately 15 degrees 30 minutes to the right. See Figure 50.

CYLINDER HEAD INSTALLATION

NOTE

New cylinder head gaskets and fire rings must be installed each time cylinder heads are removed.

1. Clean the cylinder block deck thoroughly.

2. Install new cylinder head gasket on deck. Position of gasket is determined by guide pins in the upper deck.

NOTE

Do not use a sealing compound or soak cylinder head gaskets. They are all pre-coated.

3. Install new fire ring carefully fitted over circular bead on cylinder sleeve flange. See Figure 55.

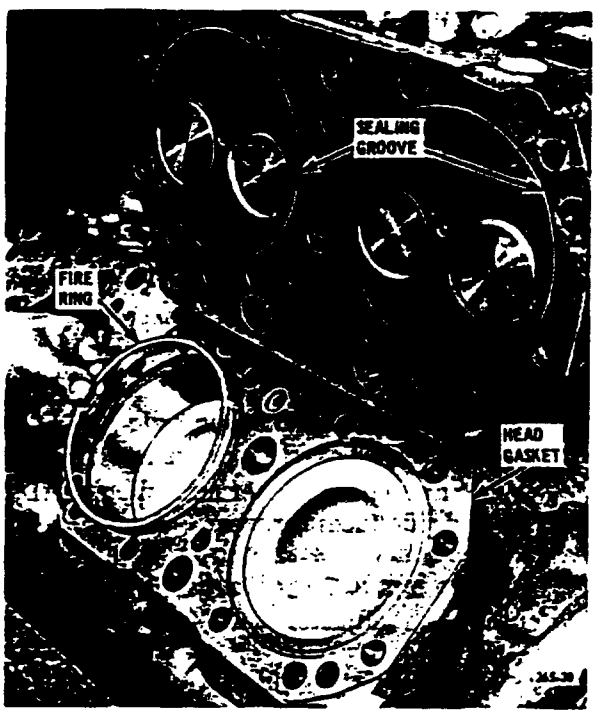


Figure 55. Cylinder Head Installation

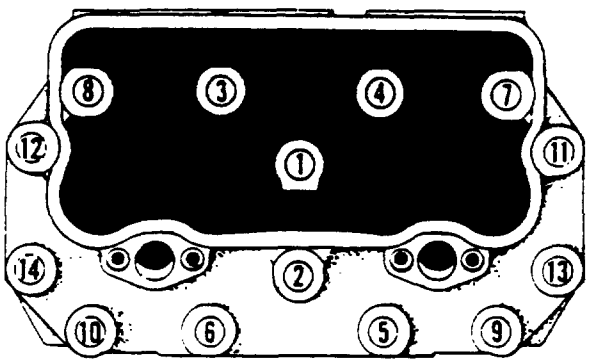
4. Clean the surface of the cylinder head and ciruclar groove for the fire ring.

5. Carefully position the cylinder head assembly over the cylinder block deck aligning the guide pins in the block with the guide holes in cylinder head.

6. Install cylinder head on block.

7. Install fourteen cylinder head capscrews.

8. Torque capscrews on each head progressively in steps of 50 to 100 to 175, and finally to 225 lb. ft. in sequence as shown. See Figure 56.



Cylinder Head Nut Tightening Sequence

Figure 56. Cylinder Head Tightening Sequence

PUSH RODS

Description

The push rods for the intake and exhaust valve rocker arms are tubular steel with spherical ends. Engines not fitted with the Dynatard engine brake feature identical 1/2 inch O.D. x 14-1/4 inch push rods; however, when the engine is fitted with the Dynatard engine brake system the exhaust valve rocker arm push rod is heavier 5/8 inch O.D. x 14-1/4 inch long.

Inspection

1. Inspect and check the push rods for length and straightness. Replace any that are bent.

2. Inspect and check the spherical surfaces for wear and tightness to tube.

Installation

Apply a light coat of lubricating oil to the spherical ends and install the push rods in the valve lifters.

4. Continue adjusting valve lash for the remaining cylinder pistons in firing order placing each cylinder piston at TDC with respective 1/4 turns of the engine crankshaft.

5. Properly secure aduusting screw locknut after each cylinder piston valve lash adjustment.

To Adjust Valve Lash Hot Idle (Not Recommended for Engines with the Dynatard Engine Brake System)

1. Start engine and warm up to normal operating temperature.

2. Set valve lash at hot idle (600 to 650 rpm) inlet valve 0.015 inch, exhaust 0.024 inch.

3. Properly secure adjusting screw lock nut after each cylinder piston valve lash adjustment.

WATER OUTLET MANIFOLD

Inspection

1. Inspect water outlet manifold for restrictions.

2. Inspect and check mounting flanges for cracks and straightness.

Installation

1. Place new gasket between right bank and left bank water manifold and the mating cylinder heads.

2. Install and tighten attaching capscrews to the proper torque.

3. Install thermostats in the right and left bank water manifolds.

4. Install thermostat gaskets, water outlet fittings, thermostat seals and water outlet by-pass elbows.

5. Secure assembly to the water manifold by installing the attaching capscrews.

INLET MANIFOLD

Inspection

1. Inspect and check the inlet manifolds for restrictions.

2. Inspect and check mounting flanges for erosion, cracks and straightness.

Installation

1. Place new gaskets between the inlet manifold and cylinder head.

2. Install right and left hand inlet manifolds and lifting eyes. Secure to cylinder head by installing attaching capscrews and tighten to the recommended torque.

3. Place a new inlet manifold fitting gasket on the top of each inlet manifold and install inlet manifold inlet fitting.

4. Install tee fitting and complete inlet manifold assembly.

EXHAUST MANIFOLD

Inspection

1. Inspect and check the exhaust manifold for restrictions.

2. Inspect and check the mounting flanges for erosion, cracks and straightness.

Installation

1. Place new gaskets between exhaust manifold and cylinder head.

2. Install and tighten the attaching capscrews and washers to the proper torque.

CYLINDER HEAD COVERS

Inspection

1. Inspect and check the cylinder head covers for cleanliness, dents and straightness of flange.

6. Check turbine wheel for radial and axial looseness. If radial and/or axial looseness is excessive, the turbocharger will have to be removed for overhaul. If turbocharger has to be overhauled, consult your Mack Branch or Distributor for details on turbocharger exchange program.

Cleaning

The compressor end of the turbocharger should be cleaned after 1000 to 2000 hours of operation. If the compressor wheel is not too dirty, it can be cleaned with the turbocharger on the engine.

Disconnect compressor discharge flange; remove the capscrews or clamp ring that holds the compressor housing to the bearing housing, and pull compressor housing carefully along turbocharger axis to prevent damage to the compressor wheel or the diffuser.

Use Bendix Metal Cleaner or equivalent solvent to clean compressor wheel. Do not use a caustic solution or any other type that may attack aluminum, as this will either weaken the impeller or destroy its balance. Do not use a wire brush or scraper; a brush with nylon or hog bristles is preferred.

If compressor wheel is found to be very dirty, remove turbocharger from the engine for cleaning. With compressor housing removed, immerse compressor wheel into the cleaning fluid and allow to soak. Use care not to rest weight of turbocharger on compressor wheel or on end of shaft.

The turbine end of turbocharger can be cleaned only after removal from the engine and separation of the bearing housing from the turbine housing.

Installation Guide

Use the following steps as a guide when installing turbocharger to engine.

1. Inspect air intake system for cleanliness, leakage and foreign material.

2. Inspect exhaust manifold for foreign material.

3. Inspect oil drain line to be sure it is not clogged or restricted.

4. Inspect oil supply line for restriction, deterioration or possibility of leaking under pressure. Be sure check valve is working properly and not restricted.

5. Inspect turbocharger mounting pad on exhaust manifold for erosion, flatness and to be sure old gasket is removed.

6. Place new gasket on exhaust manifold, position turbocharger and install attaching bolts.

7. Connect oil inlet line and oil drain line to turbocharger.

8. Connect compressor inlet and outlet piping. Check to be sure all clamps and bolts are tight. Be sure piping is not producing strain on compressor cover.

9. Crank engine, without firing, until a steady flow of oil is noted coming from the oil drain outlet of the turbocharger.

10. Stop cranking engine and connect oil drain line to engine. Be sure drain line slopes downward throughout its length with no sharp bends or kinks.

ENGINE BREAK-IN PROCEDURE AFTER OVERHAUL OR REBUILD

Comparative tests and careful review of engine break-in mehtods have proven that a short run under full load is substantially more effective than the light or no load slow speed increase type of break-in. Compatibility between the critical components (piston, rings and bores) is greatly improved by raising engine speed and applying full load immediately after warm-up.

Use the recommended type and grade engine oil and fuel as required for usual operation of the vehicle.

Immediately prior to initial starting of the engine, the fuel system, oil galleries and filters are to be primed preferably by means of a pressure tank.

Check the air intake system to be sure all joints are tight and the filter element and system are clean.